

THE INDEPENDENT GUIDE TO PERSONAL COMPUTING

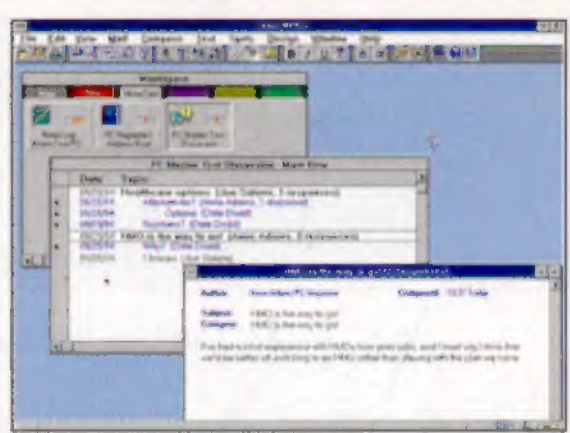
EDITORIAL
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NETWORK
EDITION

MAGAZINE

Benchmark Tests '95:
Our New Winstone,
WinBench, and
PC Bench Suites

Pretty as a Picture:
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And Affordable
Graphics Adapters



Group Therapy:
4 Products for
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ANNUAL • BUYERS' • GUIDE

Pentium *or* 486?

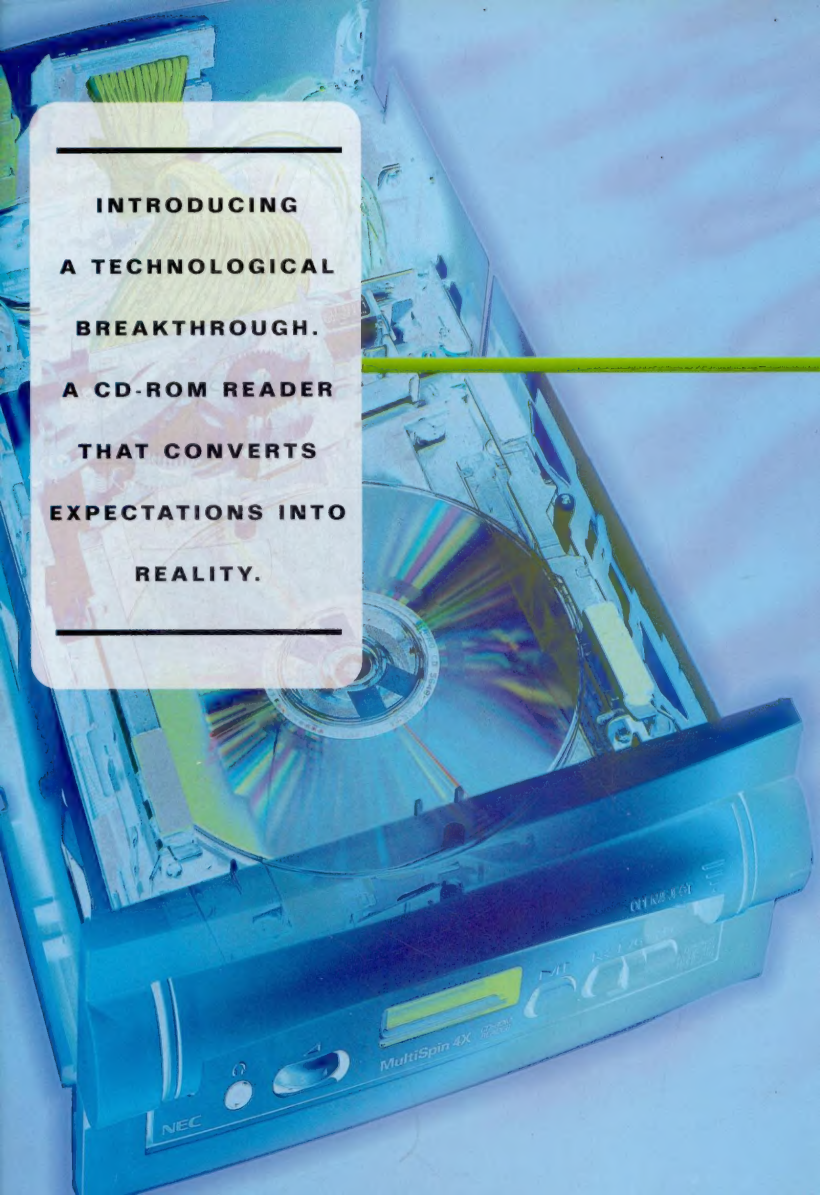


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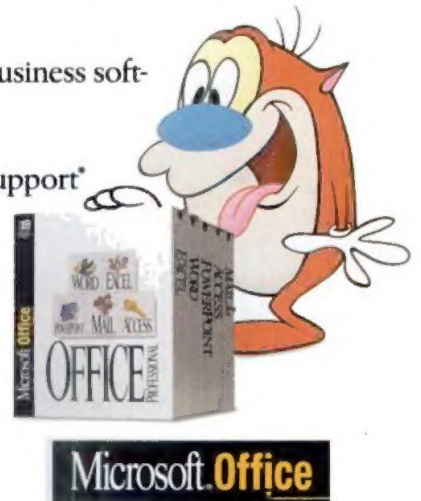
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Inside

Desktop personal computers come in all shapes and sizes and figuring out which machine is right for you is an increasingly complex task.

Consider the challenge we gave our PCs team as it prepared this issue's cover story.

We collected 165 machines, representing 66 distinct lines from 56 vendors. The machines ranged from \$1,500 486DX2/66-based machines to 90-MHz Pentium boxes that topped out at nearly \$6,000.

The task of testing these machines and interpreting the results fell to our PCs team, headed by as-

graphics and disk performance; PC Bench 9.0, which looks at processor and DOS performance; and new tests for CD-ROM drives. We factored in such things as vendor service and reliability, features, expandability, bundled software, and of course price/performance. The result is an incredibly complete report, "For Love or Money."

Of course, a PC is only as good at its components, and one of the most highly competitive areas of components and upgrades has been graphics accelerators. Our graphics team, headed by associate editor Lance Ulanoff and project leader Jeff Mace, examined 54 new graphics accelerators in their report "Rush Power."

After all this, you would think that the Labs team could sit back and relax—but alas, the industry moves much too quickly. There's a constant flow of new machines.

All this activity makes it hard to keep up, but the bright side is that we won't run out of new things to test anytime soon.

—Michael J. Miller

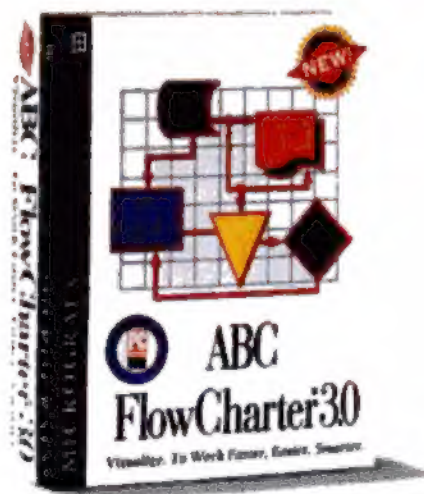


Did you say we tested 165 machines?

sociate editor John Clyman and project leader Rich Fisco in New York and senior project leader Jeff Witt at Ziff-Davis Labs in Foster City. They tested these machines with Ziff-Davis Benchmark Operation's new Winstone 95 test suite, which consists of benchmark tests based on today's best-selling applications. We also rolled out WinBench 95, which looks at specific

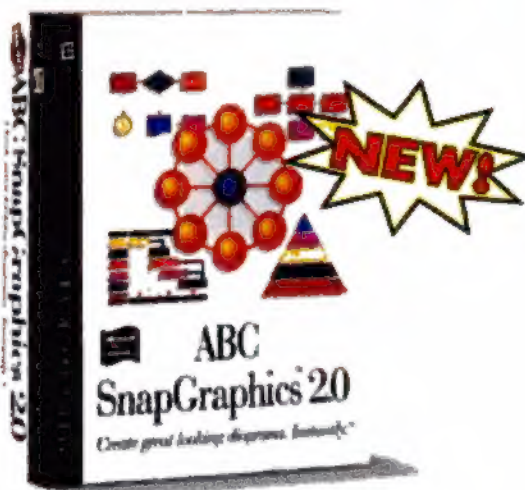
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COVER STORY

Pentium and 486 Buyers' Guide

For Love Or Money

BY BILL HOWARD

Buying a new PC that offers the level of performance you need at a price you can afford can be a daunting task. The 90-MHz Pentium—today's pinnacle of speed—may be what you want, but is it within your budget? Using our newest benchmark tests, we put 165 systems that span the performance spectrum from 486DX2/66 to Pentium/90 through their paces.....110



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After Hours

A Gift for Giving

BY GAYLE C. EHRENMAN This holiday season, instead of buying Dad another tie he doesn't need, think silicon! We've assembled a collection of more than 60 products, ranging from kids' titles to home productivity software to fun gadgets, that are bound to cover everyone on your shopping list.485



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BY JEFF MACE What a relief! The 54 graphics accelerator boards PC Magazine Labs tested show new maturity not only in terms of benchmark test performance but also usability and, most important of all, stability.239

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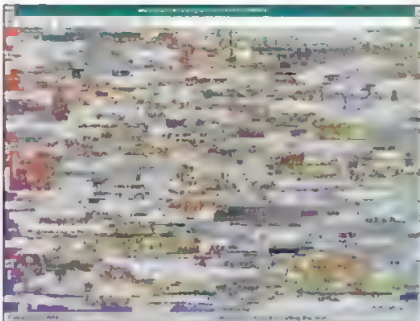
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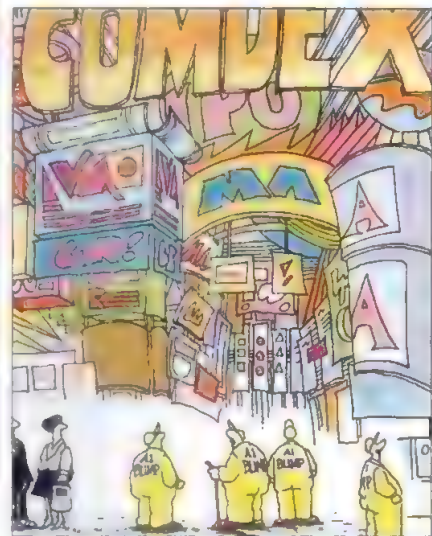


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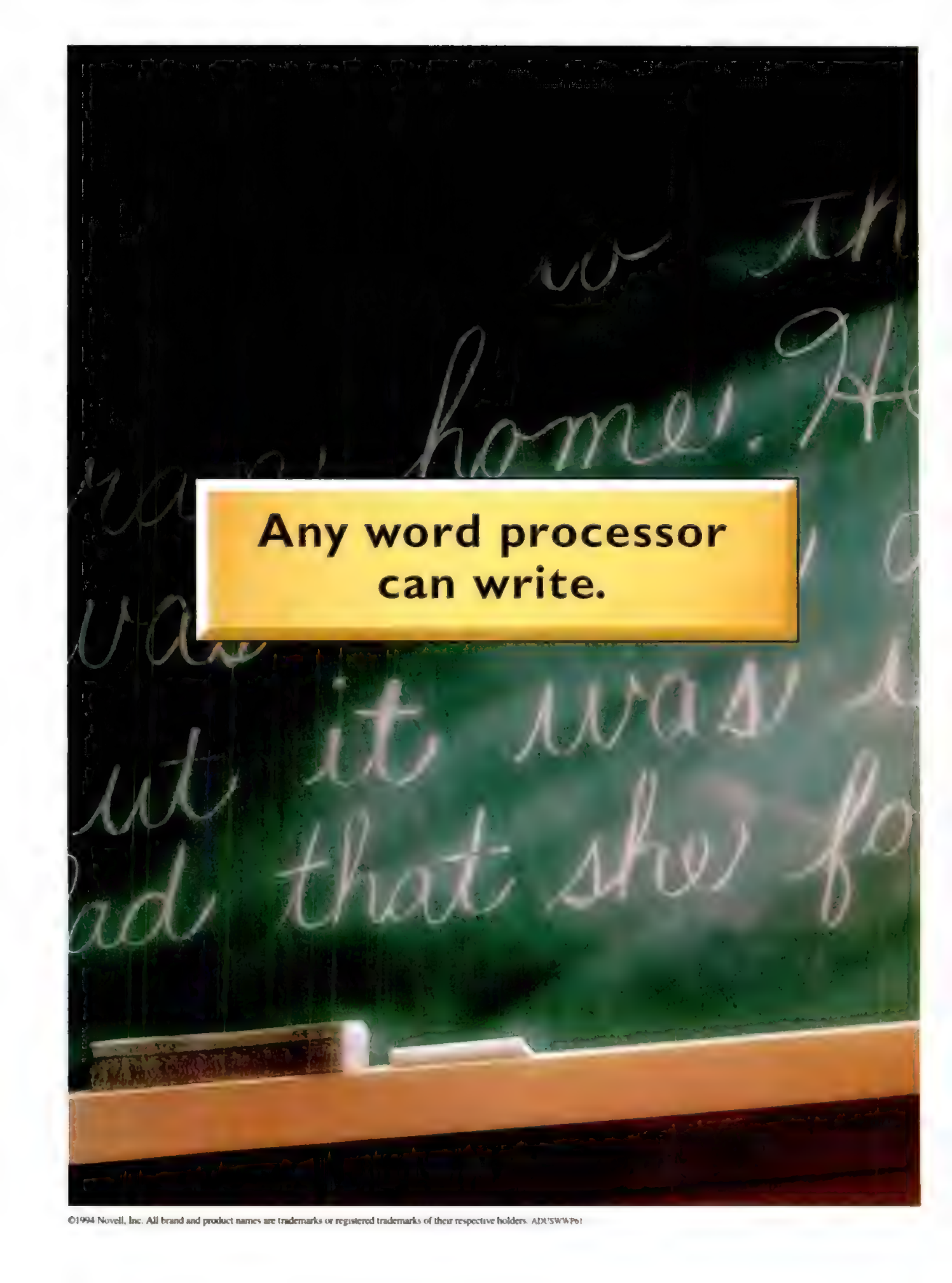


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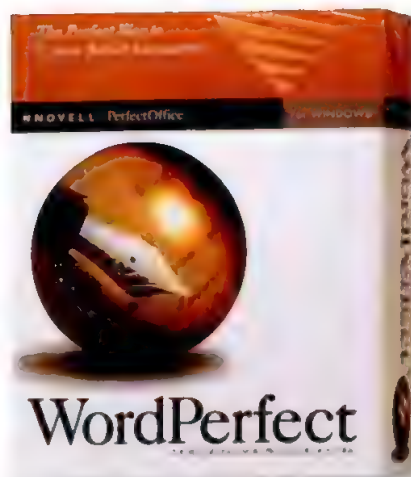
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A green chalkboard with faint, cursive handwriting in white chalk. The text on the board includes "home", "it was", and "that she". A yellow rectangular box with a black border is centered on the board, containing the text "Any word processor can write." in bold black font. The bottom of the board shows a wooden ledge with some chalk and eraser pieces.

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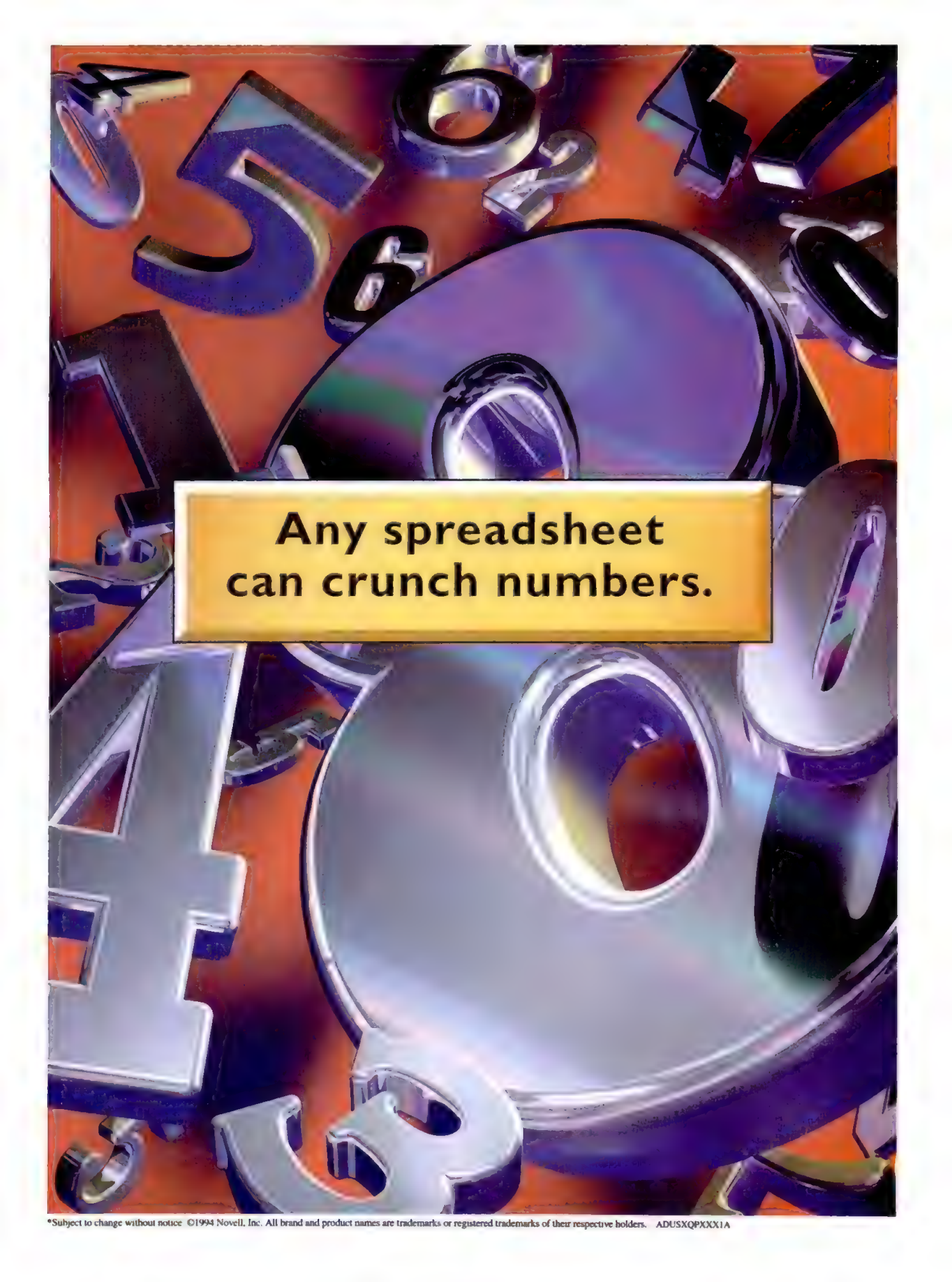
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Letters

GOOD THINGS COME IN SMALL PACKAGES

The roundup of notebook computers ("The Spectrum of Choice," August 1994) was comprehensive and, as always, useful to a prospective purchaser. Unfortunately for users, the problem still remains that to date, not one of the pointing devices implemented has been satisfactory; each has had its own set of problems. The instrument of the future will be the touch-sensitive pad that's already present on the latest generation of Apple PowerBooks. This is the best thing to hit notebooks since the development of the floppy disk.

*Jeff Szer
via the Internet*

Your August issue provided an excellent, well-rounded analysis of the current laptop computer market that proved invaluable to anyone in the market for a new notebook.

*David A. Marlin
via the Internet*

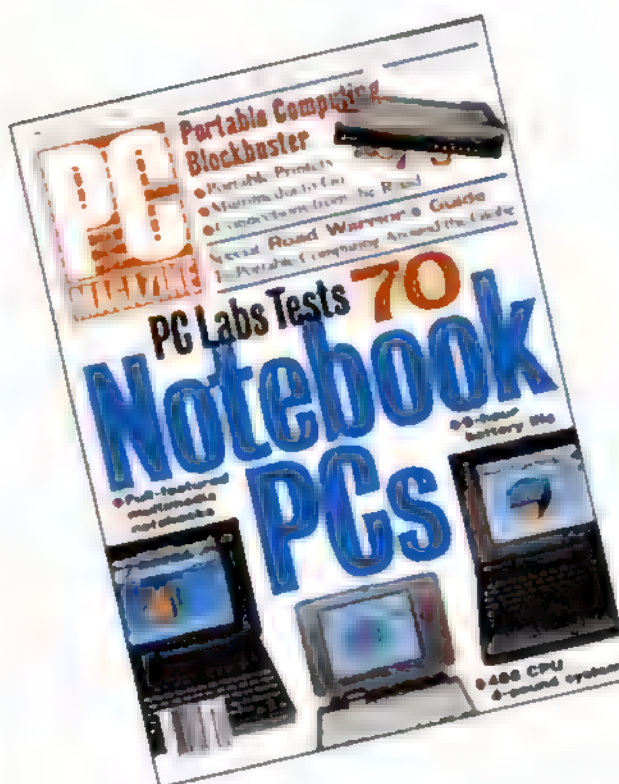
Congratulations on your portable computing issue. Your comprehensive guide helped me make my purchasing decisions. It is easily the single best roundup I've ever seen. I've found myself referring to it again and again, and I plan to continue using it as a reference.

*Alfred B. Holley
via PC MagNet*

Though the roundup of notebook computers did a really nice job at laying out all the available features of portables today, the analysis failed to dig deeper to look toward tomorrow. The ease of upgrading screens, keyboards, and pointing devices is key given the computer industry's speedy advances in technology.

*Kathy Balicki
Wyoming, Michigan*

The industry has largely missed the boat when designing subnotebook computers. The smaller size is awkward to balance on your lap, and the cramped keyboard only complicates the problem. Vendors should focus more on producing subnotebooks that are lighter and thinner than regular



*Portables' integrated
pointing devices continue
to be unsatisfactory.*

machines but with full-size keyboards and a convenient-to-carry 8.5- by 11.5-inch size.

*Luther L. Hill
Montgomery, Alabama*

ON THE ROAD, AGAIN

The special insert on mobile computing was particularly enjoyable ("On the Road," August 1994). It brought together a good deal of information that I've had to gather the hard way. Having traveled with a notebook across Europe and Asia, I would add the following pointers: Be sure the computer you buy has an auto-sensing power supply that works at from 100 to 240V AC, 50/60 Hz, so you'll only need to adapt the plug to fit the wall outlet; and if your hotel doesn't have an RJ-11 jack, try asking at the business center or front desk to borrow an adapter plug, or use a screwdriver and some clip leads.

*Dave Fugleberg
via PC MagNet*

Your "On the Road" pull-out guide ignores a couple of major problems. The RJ-11 is only one of many telephone jacks and not even all RJ-11 jacks are wired the same. (England comes to mind, but you can buy local RJ-11 adapters there.) Hard-wired telephones

are still common in many countries, and an accessory such as an acoustic coupler is often required.

*Dan Gamber
via PC MagNet*

• Many phones that have foreign connectors at the wall end use RJ-11s at the phone end.—Ed.

BEYOND THE BIGGER PICTURE

The recent review of 17-inch monitors was great ("The Bigger Picture," September 27, 1994), but it neglected to examine the monitors that vendors ship with systems under their own labels. I'm sure I'm not the only one who'd like to know how my Gateway 2000 CrystalScan rates against comparable monitors made by companies such as Nanao, Sony, and NEC.

*Bill Mackowick
via PC MagNet*

JUST THE FAX ABOUT FAXING

There appears to be a conspiracy to convert every PC user to Windows. I can understand why you wouldn't repeat your previous coverage of DOS fax programs if they have not changed, as was pointed out in your roundup of fax software ("When Is a Fax Not a Fax," September 13, 1994). The problem is that many software companies feel that we DOS users are such a minority that it wouldn't pay for them to upgrade their DOS programs.

*Robert H. Biles
via PC MagNet*

Your fax software article states, "We limited this roundup to Windows- and OS/2-based programs," and goes on to note that you found ten of the former and one of the latter. However, one of the programs reviewed—FaxWorks Pro—is available for OS/2. FaxWorks for OS/2 is multi-threaded and has other qualities that put it a notch above the Windows version. FaxWorks and FaxPM (which was included in your review) are not the only fax solutions for OS/2, just the best-known.

*Michael Kilby
via the Internet*

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LETTERS

Loved your feature on modems ("High-Speed Modems: Hurry Up and Wait," September 13, 1994). As usual, *PC Magazine* did a thorough job of weeding through all the issues and complexities users face with today's high-speed communications. Just as an update, the cost to upgrade from V.FC to V.34 was recently lowered to \$49 from the \$89 price mentioned in the article.

Nancy Stokesberry
Public Relations
Practical Peripherals Inc.
Thousand Oaks, California

Your dismissal of fax Class 2, 2.0, and CAS as irrelevant standards to consider is premature. If you need true background fax capability, then nothing short of these standards will do. Not all of us own Pentium processors, and the only way to insure reliable background fax operations on your desktop is to use a fax board that offloads work from the CPU.

Bruce Morris
via PC MagNet

Thanks for the excellent, in-depth technical background provided in the fax software and high-speed modem articles in your issue of September 13. Hats off for the superb work in compiling this material, particularly the lucid and helpful discussions of fax class considerations, binary-file transfers by fax, and the current limitations on 28.8-Kbps transmissions. Coverage like this is precisely why *PC Magazine* remains my highest authority for computing solutions at home and at work.

Jeremy McCreary
via PC MagNet

A DIFFERENT PERSPECTIVE

The First Looks review of WordPerfect's Grammatik 6.0 (September 13, 1994) makes a perfectly valid technical point: The checker misses as many errors as it finds. The question for users is whether the cup is half empty or half full. I've found that Grammatik will catch just about all the bonehead grammar and spelling errors. At the very least, Grammatik teaches users to avoid common mis-

takes, ultimately making them more competent wordsmiths if not better writers.

Bob Delaney
via the Internet

THE SOUNDS OF A VICTROLA

John C. Dvorak's comparison of the audio CD's emergence over vinyl records to the potential PowerPC revolution ("The Lessons of a Dusty Turntable," August 1994) is like comparing apples to oranges. In the music industry, vinyl records were never as good as the CD, which could provide the music of a record in a higher-sound-quality product that's easier to store and keep undamaged. However, in the IBM-compatible computer industry, the PowerPC has yet to one-up the Pentium and high-end 486 PCs.

Ryan Weaver
via the Internet

The shift from vinyl LPs to CDs has not been, as Dvorak asserts, "the result of

pent-up demand for something better." It's been due to experiences of the sort at Tower Records, which he relates: Customers arrived intending to buy LPs and found only compact disks available. Had the technologies competed directly, the shift to CDs would have been much slower.

David L. Post
via the Internet

Dvorak would be hard-pressed to find people who dumped their entire record collections. Consumers can easily and affordably add a CD player to their existing stereos and still play their favorite vinyl records; you don't have to throw away an expensive stereo system to buy a new one. But to embrace the technology of the PowerPC, consumers will have to start from scratch. That's a whole different ball game.

Daniel Surratt
via the Internet

CORRECTIONS AND AMPLIFICATIONS

The 17-inch Packard Bell monitor reviewed and awarded Editors' Choice in "The Bigger Picture" (September 27, 1994) was misidentified. We tested and reported on the Packard Bell PB8517MG. Based on information provided by Packard Bell, we incorrectly identified the unit as the Packard Bell PB8517SVGM and reported that its street price was \$650. PB8517SVGM identifies an older, discontinued model with fewer features. Packard Bell says the street price of a PB8517MG would be closer to \$900 to \$1,000, but the unit is no longer available. The Editors' Choice designation, which was based largely on the low price, is rescinded. Users who want an affordable monitor may want to consider instead the Panasonic PanaSync C1791E, a unit identical to the PB8517MG, with a selling price of about \$800.

In "Switching Hubs: Switching to the Fast Track" (October 11, 1994), the NIC Throughput test score for the Cisco Catalyst Workgroup Switch using a 1,024-byte block size should have been 38.4 megabits per second. Note, however, that our analysis in "What the

Numbers Mean," in the review itself, and in our considerations for designating the Editors' Choices was based on the correct test scores. Also, to correct a misstatement in the same article, Cisco's switch did not turn in the lowest throughput scores among switches with high-speed ports.

The correct phone number for information on the CD-ROM recorders being sold by Marcan (New & Improved, Briefs, September 13, 1994) is 206-635-7477.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016-5802. You can send electronic mail to our Internet address 157.9301@mcimail.com, or you can upload it to PC MagNet (see page 12 for access information). You can also send e-mail to individual editors. Type GO PCMSTAFF on ZiffNet for a list of addresses. All letters become the property of *PC Magazine* and are subject to editing.

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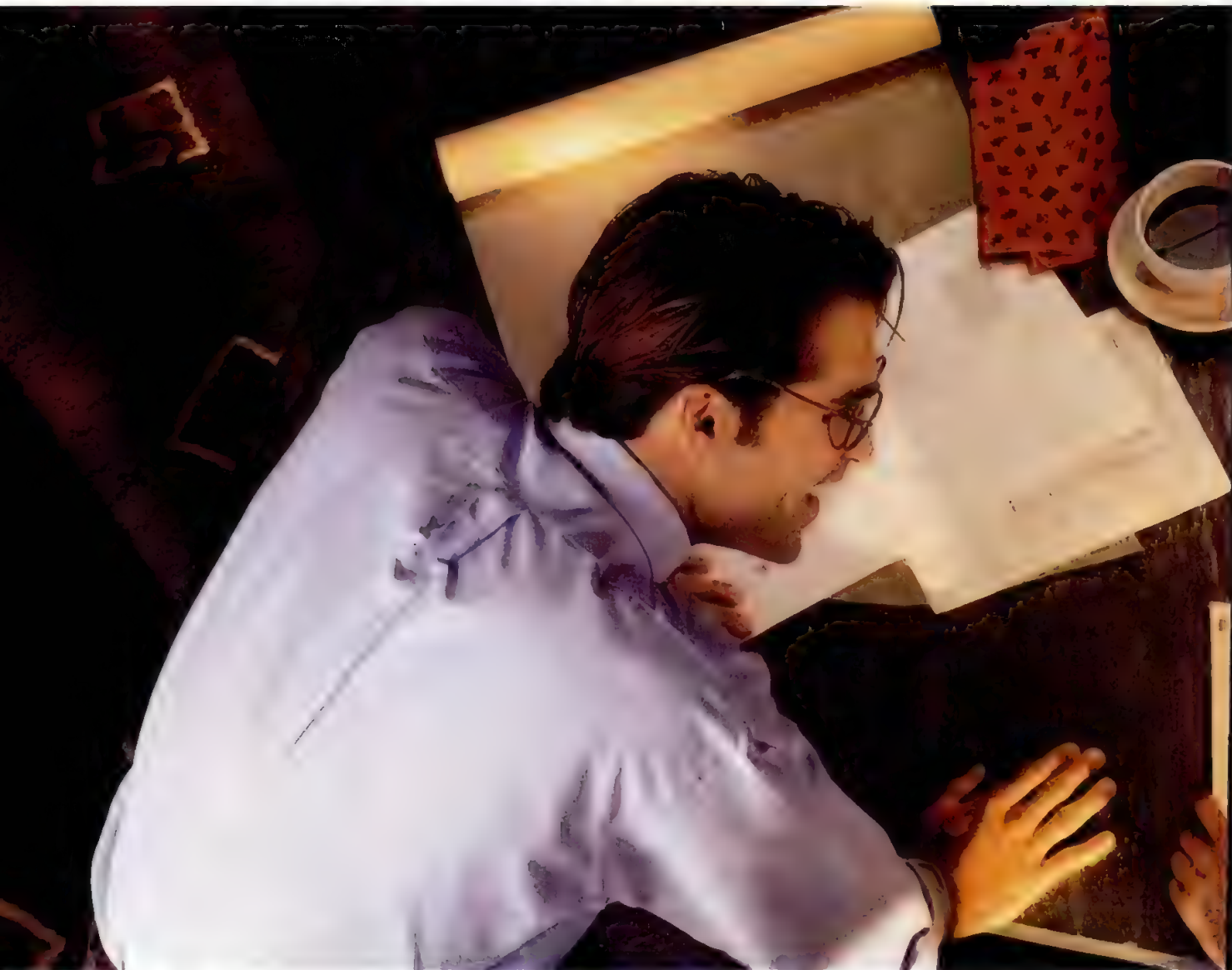


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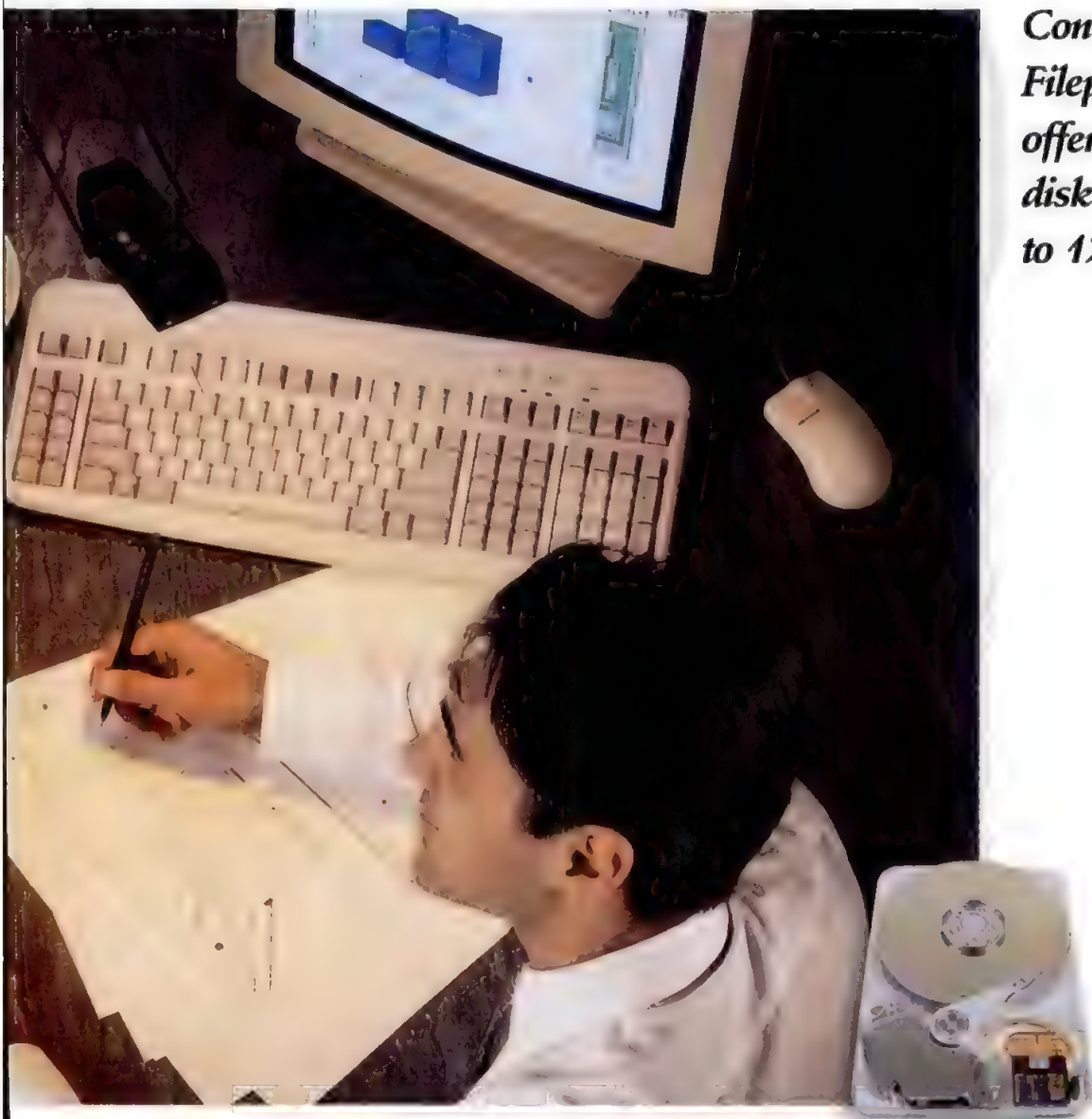
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PC World put it quite eloquently when they announced to the public, "Norton Utilities 8.0 is absolutely

SIDESTEPPING DISASTER IS A PRETTY NEAT TRICK. BUT WHO WOULD'VE THOUGHT THEY GRADED YOU ON IT?

teacher's pet. Other members of the press were equally complimentary. Statements surfaced like "the ultimate toolkit for DOS and Windows." And "Norton's new Windows Utilities can assure safer and more reliable computing than anything else on the market." Not something we would just come out and say about ourselves. But Byte and PC Magazine sure did.

"NORTON WORKS WONDERS."

More praise, courtesy of Windows Magazine. But it should come as no surprise. After all, Norton Utilities Version 7.0 was comprised of the best disk-repair and safety utilities on the market. And the critics deem version 8.0 even better.

"THE ULTIMATE TOOLKIT FOR DOS AND WINDOWS."

Like PC Computing Magazine said, Norton Utilities 8.0 works for both DOS and Windows. It has unique

you're away from your desk. And if it's been one of those days when you can't even stop for lunch, SysWatch[™], Disk Doctor[®] and Speed Disk[™] for Windows can now operate in the background.

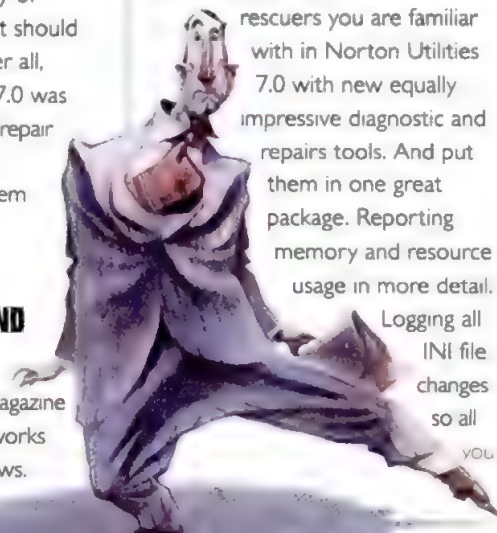
"COMBINING PRACTICAL AND FAMILIAR WITH CUTTING-EDGE TECHNOLOGY."

As PC Magazine wrote, we didn't make broad changes to the basic Norton Utilities interface. We combined all the indispensable data

rescuers you are familiar with in Norton Utilities 7.0 with new equally impressive diagnostic and repairs tools. And put them in one great package. Reporting memory and resource usage in more detail.

Logging all INI file changes so all

YOU



Desktop Utilities Report Card in the May 9, 1994 issue of InfoWorld.

essential for every PC user."

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CIRCLE 334 ON READER SERVICE CARD

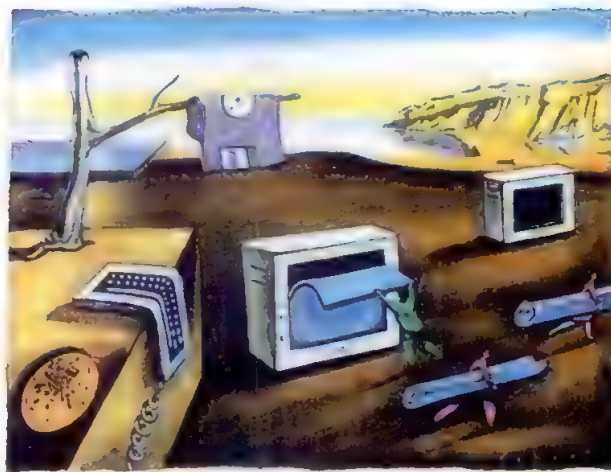
Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Roll Up Your Screen!

Plastic transistors may change the shape of portable computing.

Imagine the possibilities if you could roll up your notebook screen as you would a sheet of paper. Thanks to recent work by Francis



Garnier and his colleagues at the French National Center for Scientific Research (CNRS), we soon may see semiconductor products that are more flexible than the traditional designs based on silicon and may drive a new era of portable computing.

The flexibility comes from the use of *organic plastics*—no metal required. As shown in the diagram, special conductive polymer inks are placed on plastic films using traditional printing processes. So rather than being etched on tiny transistors and connection wires, the active elements of a circuit board or liquid crystal display screen are printed on a sheet of plastic.

According to Garnier, polymer-based transistors are not new, but their efficiency has been only about 1/1,000 as efficient as silicon designs, making them impractical. But in 1990, Garnier's group found a way to use special chemicals called conjugated oligomers to make plastic semiconductors that were about 1/100 as efficient as silicon. Around the same time, a group in Cambridge, England, developed ways to create LEDs (light-emitting diodes) using organic semiconductors. The combination of these technologies was enough to spur a new way of looking at electronic designs.

Until now, however, these designs have relied on metal conductors. Using chemical engineering to create molecules that are "self-constructing" so they align themselves correctly as they are

deposited on a surface, Garnier's group has been able to improve efficiencies and eliminate metal electrodes. The result is a transistor that's about one-tenth to one-fifth as efficient as a silicon design and also so flexible that the sheet can be rolled, bent, and twisted without damaging the connections.

Garnier's latest transistor was created using techniques with 50-micron resolution, resulting in a semiconducting channel about 100 microns wide. While this seems large compared with silicon fabrication techniques, it's already small enough for some

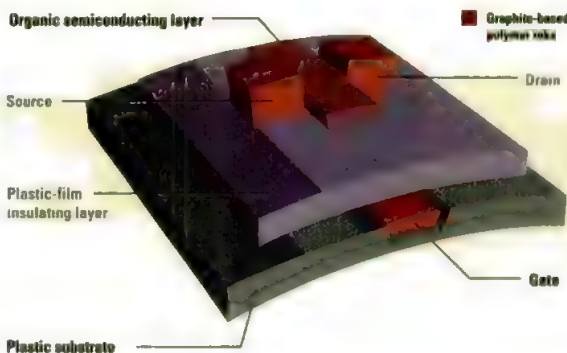
display applications; flat-panel displays use pixels that are 100 to 200 microns across. And smaller sizes should be achievable: IBM and BASF have already published research findings that demonstrate that polymer electrodes can be created at the micron level.

Garnier is confident that his group can solve some of the remaining problems of device efficiency and size. He also is working on a transparent plastic transistor using the same techniques. This would make it possible to create clear displays for cars and aircraft, which could be attached to the curved surfaces of windshields. "Plastic semiconductors won't replace amorphous silicon," Garnier points out. "We cannot think in terms of substitution; we need to think in terms of new applications. Just as plastic did not replace wood and steel in the manufacturing industry but instead led to new applications for the material, we will see different uses for these new devices."

Whether it's a moving map for your car or a credit card-size computer, plastic semiconductors may lead to some exciting new products.—*Alfred Poor*

No-Silicon Transistor

Unlike a conventional silicon transistor, a plastic transistor uses an organic polymer that can be bent, twisted, and rolled up.



Source: French National Center for Scientific Research

Pipeline *By Robin Raskin* Traveling Fonts, Part Two

Last year Adobe's Acrobat, No-Hands' Common Ground, and Farrallon's Replica raised our consciences about the importance of portable fonts. Imagine a world, they evangelized, where an electronic document travels to a new machine that's running different software and different fonts. Then imagine displaying a document that's identical to the original.

Our burgeoning desires were foiled by some serious limitations. Acrobat, Version 1.0, relied on internal font substitution; it used its multiple master fonts to reproduce the width and general style of the originals, but it only embedded fonts if they were



ornamental Adobe fonts. Also, Acrobat files were large and bulky, and the Reader portion of the program was prohibitively priced for mass distribution. Common Ground relied on bitmapped fonts for its screen display, making the screen look ugly, but it did store all the text in a format for searching. Replica embedded only TrueType fonts and used bitmapped images for Type 1 fonts, so you couldn't search for text (Version 1.01 added a substitution option).

Round Two finds a changing climate, with developments at the operating-system level. Apple's QuickDraw GX presupposes that developers will flock to develop for this richer file format. But Apple is not giving Microsoft the new font format, making it difficult for developers to commit resources. Microsoft's TrueType variant, TrueType Open, is similar to Apple GX, but without the same emphasis on rich layouts and ligature sets.

TrueType Open, however, is not proprietary. Recently, Apple announced a relationship with Ares, maker of Font Chameleon, an app that lets you adjust fonts to create new ones. How that technology figures into Apple's strategy is anyone's guess, but I suspect there's going to be a huge interest in on-line fonts.

On the applications front, it's practically hailing font solutions. Acrobat, Version 2.0, is still big and bulky, but it now embeds TrueType and Type 1 fonts, has an API for plug-ins, and includes a plug-in for full-text indexing. The Acrobat Reader is available free and is bundled with a number of apps. This summer WordPerfect shipped Envoy, which embeds a runtime viewer (but can't view embedded TrueType fonts), supports embedded TrueType, and deals well with hypertext links and annotations. Another contender, Elsewhere's FontWorks, combines Panose (which numerically describes a font) and Infinifont (a system for generating scalable fonts) into a solution for keeping font resources on the network.

My favorite long shot is BitStream's TrueDoc. BitStream, a long-time font vendor that had to reinvent its business upon the advent of TrueType, isn't planning a retail product. Instead, it has a TrueDoc software development kit (SDK) that seems simple enough to incorporate into existing products. This SDK is about to ship in Common Ground. It provides tools for recording and playing back a font. As it records, it outlines each character's shape, does automatic hinting, and compresses the file.

If all of this sounds complicated, that's because it really is. And none but the brave will use any of this until creating a portable document is as easy as pressing a Print to Portable Document button and knowing you won't lose fidelity, graphics, resolution independence, and the ability to edit. It's raining font solutions, but we're still getting drenched in the ugly details.

Robin Raskin is editor of PC Magazine.

Is Windows 95 Good News or Bad News for Memory Managers?

WITH ALL THE HOOPLA SURROUNDING Windows 95, it's easy to forget that what's good for the goose may not be good for the gander. Some third-party software developers will see their products made obsolete when Windows 95 hits the streets next year. Given that Windows apps already enjoy access to memory above 1MB and that DOS will no longer be a part of the mix, it would seem that companies offering third-party memory management products such as NetRoom, QEMM, and 386MAX stand to take an especially hard hit. Or do they?

Maybe not, according to some of the industry's leaders in squeezing that last byte of RAM from your system. For starters, they argue, Windows 95 users will be running 16-bit DOS device drivers for some time. Without a memory manager to lend a hand, these drivers will continue to consume

space in the lower 640K and deprive DOS apps of needed conventional memory. Even when the drivers are replaced with 32-bit virtual device drivers (VxDs), which is the plan, you'll still need the 16-bit versions when you drop out of Windows 95 to run games in single-application execution mode. So the need for products to maximize RAM below 640K will not immediately go away.

Furthermore, the experts argue, memory managers can help Windows applications. Sixteen-bit Windows applications will still require "global DOS memory" below 1MB. More free memory below 1MB will mean less chance of encountering "insufficient memory" messages when both memory and free system resources are plentiful. It's also possible that memory managers can make the going smoother for 32-bit Windows applications by optimizing system setup

parameters and working with memory at the VxD level.

Recent history lends credence to these arguments. Some observers predicted the demise of third-party memory managers when DOS 5.0 shipped with EMM386.EXE. But the demand for third-party memory managers increased, because people liked EMM386.EXE and wanted more of the same.

History may not repeat itself this time around. It's debatable how many users will need Windows 95's single-application execution mode. And with more people running Windows apps, the notion of what a memory manager does may need to be expanded to encompass resources other than memory.

Can Helix Software, Qualitas, Quarterdeck, and others pull another rabbit out of the hat by offering a compelling reason to buy their products? None of them will be specific, but most express excitement about the "opportunities" Windows 95 will hold for memory managers. Given their track records, it would be a mistake to count them out just yet.—*Jeff Proisie*

Preview: The New Fall Lineup

FOR ONE WEEK IN NOVEMBER, THE PC industry makes a pilgrimage to the largest technology gathering of its kind in the U.S., where throngs gather for demonstrations of new products and future technologies. Products shown at Comdex in Las Vegas this fall may well end up on your desk over the next year. Here's a preview of some of the more interesting products you will be hearing more about, including CD-ROM notebooks, hand-held printers, new video memory, remote access and wireless products, Internet front ends, and networking products.

Your biggest problem in 1995 may be deciding whether you want a 75-MHz Pentium or an internal double-speed CD-ROM in your next notebook. Because of the engineering involved in each, several major

notebook makers will have one or the other but not both. New notebook displays will be out in force, with major manufacturers showing high resolution (800-by-600) and large (11.3-inch) color screens; expect the first products early next year.

Miniaturization is also reaching new dimensions. For the portable computing market, Citizen is introducing a 1-pound color printer based on a new thermal transfer technology. (See the New & Improved section in this issue.)

Video boards are getting another speed boost with EDO (extended data out) memory, which rivals the performance of the expensive dual-ported VRAM used on high-end boards. (For more information, see "Rush Power," in this issue.) The first 128-bit board—Imagine, from Number Nine—is making its debut this fall as well. With three different frame buffers that hold a total of 42MB, Imagine should appeal to the ultra-high end of this market.

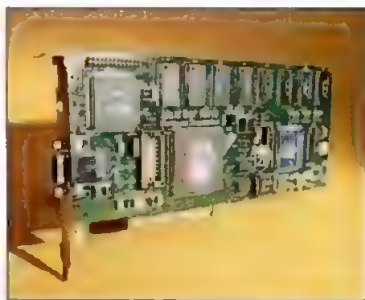
With so many people now wanting to work away from the office, the remote-access market is growing. At one time, Shiva Corp. had the field to itself, but now it has a dozen competitors, including DCA, IBM, and 3Com. Cisco has

Spyglass Inc.'s Enhanced NCSA Mosaic is an innovative package that integrates Mosaic with Adobe's Acrobat software to make it easier to publish and link documents over the World-Wide Web. The small access-service providers suddenly are finding themselves standing in the shadows of CompuServe, MCI, and Sprint, which are starting to offer Internet access, specialized information services, and ISDN services.

Networking is part of almost everything this fall. With Windows NT Server, Version 3.5, arriving at center stage, Microsoft will shepherd a large flock of companies with new NT products. Windows NT offers 32-bit memory access and true symmetrical multiprocessing. Just about every maker of application servers has dual-Pentium systems to exploit multiprocessing, and systems that support more CPUs are on the way. The NT Server package includes powerful management tools, and many companies—such as Eicon Technologies—have router and mainframe access products that are designed to interact with NT's management system.

To open the eyes of corporate managers to workgroup computing, Lotus is introducing Notes Express, a "lite" version of Notes that costs less and is easier to use than the full Notes application. And DCA is launching Open Mind, workgroup software that indexes every word you load into it so anyone on the network can search quickly.

At the network hardware level, 100-megabit-per-second Ethernet is hot. Digital, 3Com, and SMC are showing their new 10/100 Ethernet adapters that operate at both the 10-Mbps and 100-Mbps standards. These cards will cost around \$200 retail—about twice the cost of a standard 10-megabit adapter—but the extra \$100 is a good investment in the future—*Frank J. Derfler, Jr., Carol Levin, and Brian Nadel.*



Imagine, from Number Nine, is the first 128-bit graphics accelerator.

information, see "Rush Power," in this issue.) The first 128-bit board—Imagine, from Number Nine—is making its debut this fall as well. With three different frame buffers that hold a total of 42MB, Imagine should appeal to the ultra-high end of this market.



Zenith's CruisePad is a 3-pound "wireless remote interface."

joined the ranks of those offering remote-LAN and LAN-to-LAN access products, and relatively new companies such as Solecetek are pushing wire-less connectivity in every direction.

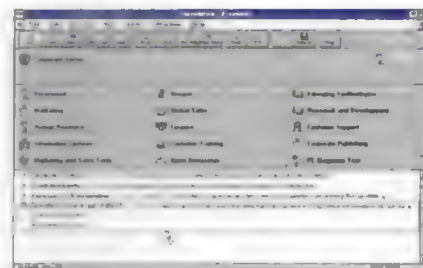
Zenith Data Systems is taking a new approach to remote computing with CruisePad, a 3-pound "wireless remote interface" that uses the spread-spectrum radio technology developed by the defense industry to access documents on your desktop PC. With LCD screen and keyboard in hand, you can roam around the office and remain connected to your network.

Meanwhile, Internet software is maturing. Spry's Internet In A Box is perhaps the best integrated of all the enhanced versions of the Mosaic Internet access software.

Top Retail Software

Current ranking	Last issue	Product/company
1	1	MS-DOS 6.22 Upgrade Microsoft Corp.
2	—	MS Publisher 2.0 for Windows Microsoft Corp.
3	3	Procomm Plus for Windows 2.0 Datastorm Technologies
4	—	Internet Membership Kit 1.0 Ventana Media
5	4	MS Windows 3.11 Microsoft Corp.
6	—	QEMM 7.5 Quarterdeck Office Systems
7	2	WinFax PRO 4.0 Delrina Corp.
8	—	Procomm Plus 2.01 Datastorm Technologies
9	—	The Norton Utilities 8.0 Symantec Corp.
10	—	Internet Starter Kit Que Software

This list ranks PC business programs according to the total number of copies shipped to over 12,000 stores and resellers in the week ending October 8, 1994; the list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.



DCA's Open Mind, a research and discussion tool, is a new workgroup software package.

All-in-One Multimedia Boards

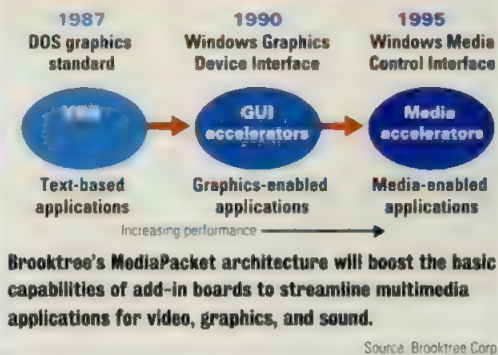
THIS SPRING, KEEP AN EYE OUT FOR a new kind of add-in board—an all-in-one multimedia subsystem that does video capture, wavetable synthesis, software MPEG playback, digital sound, Windows accelerated graphics, and playback of full-motion, full-screen video. Oh, and it's affordable (around \$350) and easy to install, too.

PC and board manufacturers are now working with a new chip set from Brooktree, maker of digital-to-analog converters for video boards, for use in future products. The single chip set approach is an alternative to the way multimedia systems are built today—as a hodgepodge collection of sound and video boards, each with a variety of components glued on.

"We think this is going to give people the kind of TV-quality playback they've been looking for as a standard part of the PC architecture," says Tom Clarkson, vice pres-

ident of marketing, multimedia division, at Brooktree. In completely rethinking how PCs manage multimedia data, Brooktree came up with *media packet* architecture, which enables a single board to handle multiple data types. It identifies data as a video packet, a graphics packet, or a sound packet. When data enters a multimedia board, it's

Multimedia Marches Forward



assigned a packet identifier and placed in the media buffer. Brooktree's PACDAC (packet digital-to-analog converter) then reads these packet identifiers, converting them into video, sound, or graphics.

The result is VCR-quality video at 30 frames per second and all-digital sound. "The chip set solves the problem of slow and blocky video playback since it does the video expansion and color-space conversion in the DAC after the information is stored in the media buffer," explains Clarkson. Most of the other architectures expand the image before the information is stored in the media buffer, which means you need at least 2MB of video memory to do video playback.

The key is storing video in its native format, which is called YUV (a term that describes the colorspace in which video is stored). Then, at the back end of the process, the DAC expands the picture and displays it on the monitor.

There's more in store. "If you think about it, you can have more types of packets in a media buffer," says Clarkson. "Wouldn't it be cool if we could integrate ATM data into the same conceptual packet architecture, so you could do video-streaming processing for video conferencing on high-bandwidth WAN and LAN networks?" It sure would. —Carol Levin

Digital Visionaries

DO YOU ENJOY USING YOUR PC? IF the answer is no, you're not alone. Clifford Nass, an associate professor in communications at Stanford University in California, is



Nass: Perception is key.

one of a handful of researchers who study how people interact with computers. Nass and Stanford colleague Byron Reeves are conducting behavioral studies of human interaction with computers.

Partly funded by Apple, IBM, and Microsoft, the research has subtly transformed products made by these companies.

Q: What's wrong with interfaces today?

C.N.: Almost everything. Interfaces sacrifice cooperative interaction for precision. Small, incremental changes to Windows aren't going to be enough. The user interface needs a whole rethinking, starting from a very different premise. The radical shift will be that new interfaces will focus more on a user's perceptions of the experience than on the actual experience. Speed and functionality are going to become less

important, while perceived functionality and user enjoyment will become more important.

Q: What have you discovered about human/computer interaction?

C.N.: We've been exploring the theory that individual interactions with computers are fundamentally social. For a long time, human/computer interaction was an engineering problem. Where do we put the key to maximize speed? You're not going to understand how people feel from that. Rather than using focus groups, which are very crude methods of measurement, you can use methods ranging from questionnaires to EEG and EKG results to study physiological responses. We've done research on teamwork, and all you have to do is label a computer a teammate and people like it much better. By simply changing interface wording, we gave computers either dominant [where the computer prompts you] or submissive [where the computer responds to your input] personalities. Confident people preferred the confident, dominant computer, while under-confident people preferred the submissive computer. And that's exactly what happens with people—people like people like themselves.

Q: What's driving the next-generation computer interface?

C.N.: Interactive television, agents, and artificial intelligence systems are driving the

next-generation interface. But more than technology, the need to grow a consumer market is going to drive the evolution of the interface. Until now, interfaces have not been designed to respond to what people want or to feelings. They were designed around efficiency. It's a case of understanding human social reactions. —Melissa J. Perenson

Briefs

THE TOP-SELLING PC MANUFACTURERS

are Compaq, Apple, Packard Bell, IBM, and Gateway 2000, reports market research firm Dataquest. Rankings are based on shipments for the first half of 1994. Rankings for the same period last year were Apple, IBM, Compaq, Packard Bell, Dell, and Gateway 2000.

HOUSEHOLDS WITH SUBSCRIPTIONS TO

on-line services read more science, technology, and business news and watch less TV than other households, concludes a recent survey of American households by FIND/ SVP. Internet households are affluent, own fax machines, pocket electronics, and cellular phones. —Carol Levin

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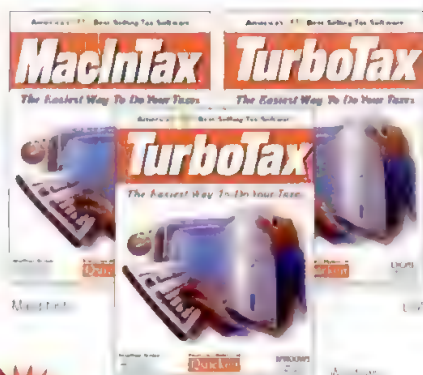
3 The Omitted Form
Even "ordinary" returns require anywhere from six to a dozen forms to complete. It's easy to miss one or end up rushing all over town to find the one you need.

4 The Misinterpreted Instruction
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5 The Overlooked Deduction
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6 The Exceeded Guideline
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

Portables

75-MHz Toshiba Notebook Makes Pentium Portable

BY BRIAN NADEL

If the outer appearance of the Toshiba T4900CT notebook looks familiar, it should—the unit's case and design are essentially the same as the ones that were used for the last two generations of Toshiba notebooks. But the \$7,495 T4900CT is much more than an extension of Toshiba's T-series of high-end notebooks. What makes the T4900CT different is its processor—the first of a new generation of low-voltage Pentium CPUs specifically designed for portables—and its display—a high-contrast, 10.4-inch active-matrix screen that yields rich, saturated colors. Toshiba not only has the highest performance portable currently available, but in terms of raw power, the T4900CT also bridges much of the gap that currently exists between notebooks and desktop PCs.

NOTEBOOK WISH LIST

The features of Toshiba's flagship notebook read like a traveling executive's wish list: 16-bit stereo sound, 772MB hard disk, VL-Bus accelerated graphics, and a Type III PCMCIA slot—all in a 6.6-pound package, which is a few ounces lighter than Toshiba's T4700 and T4800 systems.

The system's full-size keyboard uses an Accupoint eraser-

head pointing device that is mounted between the G, H, and B keys. While this is a long-awaited step up from the snap-on BallPoint trackball, the placement of the actuation buttons—on the front of the case below the keyboard—is awkward and will take some getting used to.

In order to enhance modularity across the Toshiba line, the



SO HOT, SO COOL: The Toshiba T4900CT produces the highest level of PC performance in a notebook while keeping its cool.

T4900 can connect to Toshiba's existing Desk Station IV docking system.

DESKTOP IN YOUR BRIEFCASE

Most desktop Pentium PCs rely on external cache to keep the information-hungry Pentium processor fed with instructions and data. In a portable, the required 3.3-volt SRAM chips, which are hard to come by, also drain battery power. Toshiba's answer was to design the T4900CT around extended data-

out memory (EDO), which makes the data held in the system memory available to the processor longer than standard DRAM chips. The result is performance that is comparable to that of an external-cache-based system, but with the added benefit of potentially greater battery life.

Another semiconductor advance contained in the T4900 notebook is its use of Intel's tab carrier Pentium processor. This low-profile package occupies two-thirds less space than the traditional desktop Pentium packaging and allows for greater heat dissipation, so no fan is needed to cool the system. According to Intel, the 75-MHz Pentium chip weighs just 1 gram and draws 3 watts at full power—about half that of a desktop-based 90-MHz Pentium processor.

Overall performance of the Pentium/75-equipped T4900CT was nothing short of exceptional for a system that fits into a briefcase. With a score of 140 on our CPUmark₁₆ tests, the T4900CT is between a 66-MHz and a 90-MHz Pentium desktop in terms of processor performance. When it comes to the T4900CT's ability to complete applications as measured with our Winstone 95 benchmark tests, the Toshiba Pentium notebook's score of 66 stands above 100-MHz

486DX4-based notebooks.

At just under 2 hours, battery life for the T4900CT's nickel hydride cells was acceptable, particularly in light of the fact that our new WinBoink battery test presents a worst-case scenario for power drain by constantly using system resources. Depending on your particular style of computing, and with the notebook's power-saving features enabled, you're likely to get greater battery performance.

With the Toshiba T4900CT, you can have it all: approximately twice the performance of a 75-MHz 486DX4 notebook and comparable battery life to boot.

► **Toshiba T4900CT.** List price: *With Pentium/75 CPU, 8MB RAM, 772MB hard disk, 10.4-inch active-matrix color display*, \$7,495. Toshiba America Information Systems Inc., Irvine, California; 800-334-3445, 714-583-8000; fax, 714-583-3800

Circle 437 on reader service card.

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■ Portables

IBM, MPC, and Panasonic Usher in the CD-ROM Era of Portable Computing

BY TIN ALBANO

It had to happen, and it did. We've grown so accustomed to CD-ROM drives on the desktop and have so accepted CDs as the preferred method of exchanging large amounts of data and loading overweight software packages, that it was only a matter of time before notebooks with integrated CD-ROM drives would become the next evolutionary mutation of the portable PC.

From IBM, MPC Technologies, and Panasonic Personal Computer, we have the first three notebook PCs that include built-in, full-size, double-speed CD-ROM drives. In addition, all three companies have equipped their respective notebooks with 16-bit audio capability, built-in speakers, and large color screens, making them perfect for on-the-road presentations.



MULTIMEDIA THINKPAD: IBM has given its popular ThinkPad series a CD-ROM twist with a removable drive.

The resulting products—the IBM ThinkPad 755CD, the MPC CD-Book 875, and the Panasonic V41—are the closest we've come to real desktop replacements. They are the first true, self-contained portable multimedia machines.

These systems go beyond

meeting the MPC II second-generation standards for multimedia applications by making multimedia truly portable. Indeed, the only competition these three systems have are the luggable PCs sold by Compaq, Dolch, and Toshiba. But with these CD-ROM-equipped notebooks from IBM, MPC, and Panasonic, you get freedom from an electrical outlet.

The CD-ROM notebooks are definitely worth getting excited about, but unless portable multimedia capability is an absolute must or you have a king-size wallet, don't get rid of your current notebook quite yet. As with any new technology, certain sacrifices have to be made and hurdles cleared with these units. In this case, the biggest hurdles to overcome were designing a unit that maintained a notebook's form factor, keeping the floppy disk drive inside the unit and maintaining an acceptable degree of battery life.

These units buck the expected trend in laptop manufacturing towards ever smaller and lighter machines, and push the boundaries of acceptable notebook size and weight. The largest and heaviest system, the Panasonic V41, has a travel weight of over 9 pounds and measures a seam-splitting 11.7 by 9.3 by 2.3 inches. And the IBM machine, while closest to notebook size and feel, costs about the same as an economy car.

If your pocket is deep enough and your briefcase is large enough, any one of these notebooks will properly launch

you into the next generation of portable computing while making you the envy of every laptop-toting business executive.

IBM THINKPAD 755CD

IBM had a head start over its competition in the race to integrate a CD-ROM into a notebook's svelte case.

Two years ago, IBM had already paved the way for CD-ROM-equipped notebooks with the design of the original ThinkPad 755. All it took was engineering a CD-ROM drive that could fit into the ThinkPad's multimedia slot—which can alternatively house a floppy disk drive, a TV tuner, or a wireless communications module. The bad news is that the 755CD is about half an inch taller than its non-CD sibling, the 755C.

The use of the CD-ROM drive requires that you pull out the floppy disk drive; at present, both can not be used at once. Inserting a CD is easier with the ThinkPad 755CD than either of its two competitors. Rather than lifting the keyboard, as you must do with the V41 and the CD-Book 875, CDs are loaded directly in the front of the 755CD.

The 755CD is not only the closest in size and feel to a standard notebook, it is also the most technologically savvy of the three units. The 755CD's list of features and abilities is impressive. Starting with a 10.4-inch active-matrix screen and a VL-Bus 32-bit accelerated local-bus graphics subsystem, the 755CD not only displays simultaneous external SVGA, it can also capture video. The unit is equipped to handle NTSC and PAL tele-

vision signals bidirectionally.

The overall performance of the 755CD was what you'd expect from a 100-MHz machine: excellent. The 755CD's Winstone 95 score, which measures the unit's ability to use the most popular Windows applications, was 56. This puts it in the same class as other DX4/100 notebooks.

On the other hand, you must sacrifice some battery life. On our new WinBoink test, which is



MPC COMPATIBLE MPC: The MPC CD-Book 875 makes portable multimedia affordable.

a worst-case test that measures continuous use with power conservation disabled, the 755CD lasted for 2 hours 4 seconds on a charge. As with fuel economy estimates, your mileage will vary based on your power management settings and the intensity of your work.

The 755CD gives you something that neither the MPC nor the Panasonic notebooks do: the ability to print directly or transfer files via its infrared port. Compliant with the IRDA standard, the system can move data at the rate of 1.2 megabits per second.

Considering the whole package—large bright color screen, high-speed processor, and CD-ROM—if you can afford the \$7,599 price, you'll find the ThinkPad 755CD is worth every penny.

MPC CD-BOOK 875

Engineers at MPC Technologies did away with its system's internal floppy disk drive, opting

First Looks

instead for an external unit to make room for a CD-ROM drive. The MPC CD-Book 875 was the bulkiest of the three units we tested and used a 75-MHz DX4 processor, so it didn't perform as well as its 100-MHz-equipped competitors. But it was the cheapest system we looked at with its affordable \$3,158 price tag.

The CD-Book's list of features isn't quite as stunning as the IBM ThinkPad's. The unit we tested was equipped with a 9.5-inch dual-scan color screen.

*The Panasonic design just
may be the one
other manufacturers
wind up copying.*

While adequate for normal business use, it's certainly not the kind of display one would want on a high-powered multimedia presentation system. MPC does offer an active-matrix color-screen option for about \$1,000.

While the unit uses a DX4/75 processor, its performance was in the same league as the 100-MHz IBM and Panasonic machines on our Winstone 95 tests. Its battery life of just over an hour was a little disappointing, however. One caveat on the unit's design, which is based on a design by HyperData: The motherboard is exposed whenever you lift up the keyboard to change a CD. In addition, the MPC CD-Book 875 occasionally had trouble recognizing when a disk had been changed, requiring that Windows be restarted.

The MPC CD-Book 875 also uses one of the oddest looking pointing devices. In the lower right corner of the keyboard, to the right of the system's reduced-length Spacebar, there are three small buttons: a circular-center touch-sensitive pointing controller, surrounded

by a pair of rectangular actuation buttons. It took some time to get used to, but this approach actually is useful for navigating through Windows without taking your hands from the keyboard. It is every bit as good as the IBM's TrackPoint III pointing stick and the Panasonic's front-mounted trackball—only different.

Overall, the \$3,158 CD-Book 875 proved to be a reliable, relatively inexpensive entry-level multimedia machine.

PANASONIC V41

Of the three machines we tested, the Panasonic was closest to our ideal of what a CD-ROM notebook should look like. The design engineers at Panasonic built the V41 specifically to house

their latest CD-ROM drive, and for the most part used Matsushita (Panasonic's Japanese corporate parent) parts. Unlike the IBM and MPC, Panasonic did not have to sacrifice an internal floppy disk drive to fashion its unit with a CD-ROM. The downside is size and weight. But even though it is heavier than the other two units we tested, the Panasonic V41 was certainly the best-designed CD-ROM-equipped notebook. Its design just may be the one other

notebook manufacturers wind up copying.

In fact, this unit's design is so good that you can take out the CD-ROM drive and use the slot for an extra battery or a television-tuner, as well as for other Panasonic-built devices that are now in the planning stages (including an MPEG video compression module). There is also room under the keyboard to store an additional disk, if you should so desire.

In terms of performance, the V41 stayed right on the ThinkPad 755CD's heels and even outperformed it on our Graphics WinMark 95 tests. The most glaring problem was the unit's battery life. At just over 51 minutes, you'll be forced to keep your presentations down to a bare minimum (or never stray too far from an outlet).

There are only two things left for these and other notebook manufacturers to do: Increase the battery performance of these first true multimedia portables, and put them on a diet to shrink them down in size. Once that happens, CD-ROM-equipped notebooks will definitely carve a niche into the portable PC market.



PEEK UNDER THE HOOD: The Panasonic V41's innovative design launches a new generation of notebooks.

ThinkPad 755CD. List price: With 8MB RAM, 540MB hard disk, \$7,599. IBM Personal Computer Co., Somers, New York; 800-426-2968, 800-772-2227; fax, 800-426-4329.

Circle 434 on reader service card

MPC CD-Book 875. List Price: With DX4/75 CPU, 8MB RAM, 340MB hard disk, \$3,158. MPC Technologies, Santa Ana, California; 800-672-8088; fax, 714-724-9648.

Circle 435 on reader service card

Panasonic V41. List Price: With 8MB RAM, 450MB hard disk, \$6,599. Panasonic Personal Computer Co., Secaucus, New Jersey; 800-742-8086, 201-271-3182; fax, 201-392-6618.

Circle 436 on reader service card

Benchmark Tests: CD-ROM-Equipped Notebooks



These three CD-ROM-outfitted notebooks from IBM Personal Computer Co., MPC Technologies, and Panasonic Personal Computer Co. turned in respectable performance. The IBM ThinkPad 755CD and the Panasonic V41, both equipped with DX4/100s, produced similar scores. The DX4/75-based MPC CD-Book 875 posted the scores we expected from a 75-MHz notebook. All three units had poor

battery performance results, but that too was expected: All have color screens and CD-ROM drives.

PC Magazine Labs used Winstone 95, Version 1.0, WinBench 95, Version 1.0, and PC Bench Version 9.0, to measure the performance of these notebook PCs. We used WinBench to test the battery performance of these systems; the results represent battery life under a worst-case scenario.

Higher scores represent better performance.	Winstone 95 (score)	Graphics WinMark 95 (millions of pixels per second)	Disk WinMark 95 (score)	DOSmark (score)	CPUmark (score)	DOS Video (score)	DOS Disk (score)	WinBench (minutes:seconds)
IBM ThinkPad 755CD (Intel DX4/100)	56	4.7	260	350	54	1.843	451	2:05
MPC CD Book 875 (Intel DX4/75)	60	3.1	350	364	54	1.843	350	1:02
Panasonic V41 (Intel DX4 100)	55	7.3	260	350	54	3.852	453	0:51

■ Electronic Photography

Kodak DCS 420 Camera: Say Cheese And Forget About Film

BY BILL HOWARD AND
THOM O'CONNOR

Eleven thousand dollars for a camera may sound like a lot of money, but the Kodak DCS 420C can have an enormous potential payback, particularly if you take a lot of pictures. A modified Nikon N90 camera that uses standard lenses, the \$10,995 DCS 420C camera takes high-quality electronic photographs without costly film and processing. The digital images can be sent directly to a printing press without expensive, time-consuming separations or scans.

Image quality is significantly better than the sub-\$1,000 Apple QuickTake 100 and Logitech Fotoman Plus cameras, which essentially produce digital snapshots. Images on the DCS 420 are captured by a CCD (charge-coupled device) rather than film, and are stored on an included 105MB PCMCIA Type III hard disk (which holds 62 exposures per disk). Alternatively, the digital photographs can be transferred to a Macintosh computer via a SCSI connection that is built into the camera. The SCSI link for the PC is expected soon. The CCD image target measures 1,524 by 1,012 pixels and produces 12 bits per RGB color channel, or a total of 36-bit color. The camera's battery pack is good for about 1,000 shots.

POINT AND SHOOT

To use the camera, you simply turn it on, aim, and shoot. You can shoot the first photo in a quarter of a second and fire off a five-frame burst in 2.25 seconds. The DCS 420C is extremely quiet—just a soft thunk as the viewing mirror pops out of the way, then an almost inaudible whirl as the drive spins up. The images are then written to disk at the rate of 2 to 3 seconds per

image. To move the images from the hard disk in the camera to your PC will require a desktop PCMCIA card reader.

You can adjust the camera's film speed from the equivalent of ASA 50 to 400 for color images or from 100 to 800 for black-and-white shots. The images are immediately available for viewing, which is not the case with cameras that use film that has to be developed. In addition, you can erase any mistake.

Several aspects of the camera took some getting used to. First, it is taller than a conventional camera, and its 3.6-pound heft can feel awkward. Second, the CCD covers only 38 percent of a 35-mm film frame, so the active

area of the viewfinder is a small rectangle in the middle. This increases the effective focal length of any lens by a factor of 2.6, so a 50-mm wide-angle lens effectively becomes a 130-mm telephoto lens. Moving images from the camera is a two-step process that entails loading the



SHOOT: The Kodak DCS 420C can render a digital photograph immediately by placing the image on a PCMCIA hard disk.

image file on your PC's hard disk and viewing it in low resolution with Kodak software. Only then can you transfer the images—which typically take up about 4.5MB each—to a Twain-compliant image editing program such as Aldus PhotoStyler. The initial images we took had a reddish tinge, but it's a simple matter to color-correct them with image-editing software.

In addition to saving on film and processing, the DCS 420C puts an end to the roughly \$35 cost of a conventional high-resolution prepress scan of a color image (required for newspaper and magazine publishing). The Kodak DCS 420C could thus pay for itself in less than 200 images. If your needs run to even higher resolution, Kodak has announced a 3,060-by-2,036 pixel electronic camera (also based on the N90), which will sell for \$27,995.

► **Kodak DCS 420C.** List price: \$10,995. Requires: 320KB hard disk space, Microsoft Windows 3.x. Eastman Kodak Co., Rochester, New York; 800-242-2424, 716-724-6888.

Circle 432 on reader service card

■ Apple's Digital Camera Goes Windows

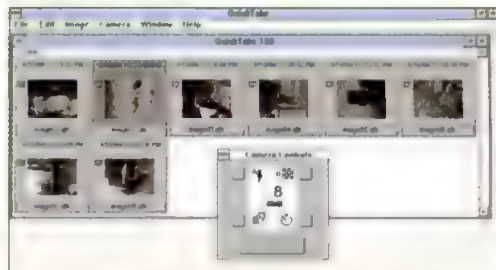
Formerly a Macintosh exclusive, Apple's \$749 QuickTake 100 24-bit color filmless camera now works with any PC running Windows. This nifty hand-held point-and-shoot electronic box camera uses a low-power memory chip to store its 8,640-by-480 resolution or 32,320-by-240 resolution images. The photos are off-loaded to the computer via the serial port.

The Windows program is very simple and incredibly easy to use. Not surprisingly, its look, feel and commands are virtually identical to the Mac version. It took us 7 minutes 15 seconds to upload 8 QuickTake 100 high-resolution images to the Macintosh, while transferring the same images as TIFF or .PCX files to a 486 PC with a 16550 UART running at 57,500 bps took us 6 minutes 40 seconds. Obviously, the use of a high-speed serial board is a must with this camera.

Like the Mac version, the Windows software has no image editing capabilities. For that, you'll need Photoshop, Picture Windows, or some other image editing program. —Daniel Grotta and Sally Wiener Grotta

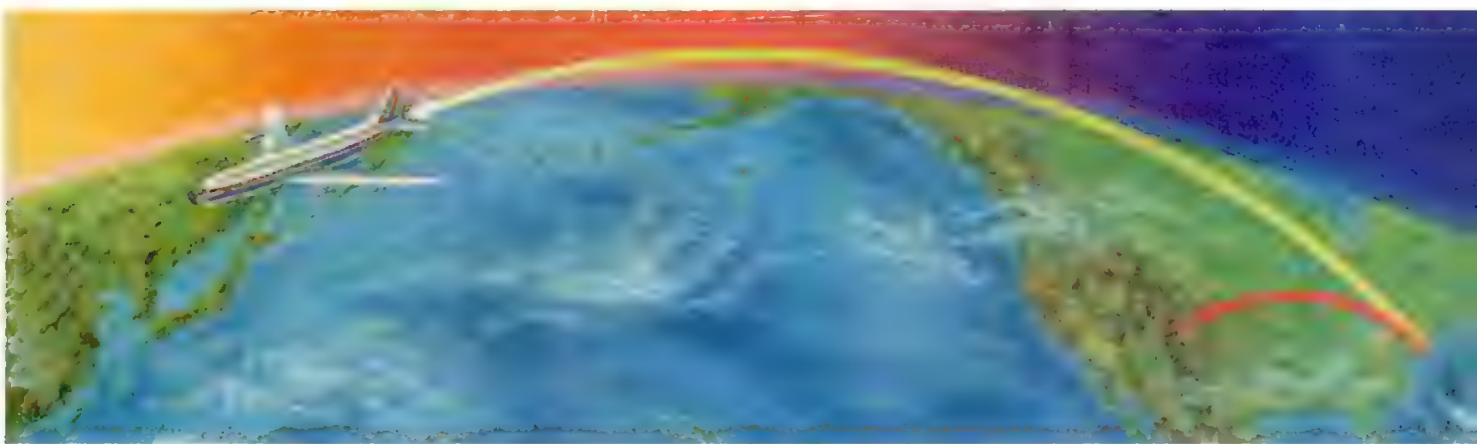
► **QuickTake 100.** List price: \$749. Requires: 2MB RAM, 10MB hard disk space, Microsoft Windows 3.1 or later. Apple Computer Inc., Cupertino, California. 800-776-2333.

Circle 433 on reader service card



VIEW: The Apple QuickTake 100 allows you to choose which photos you want to transfer to your desktop PC.

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■ File Managers

XTreeGold for Windows Keeps DOS in Mind

BY DON WILLMOTT

XTreeGold 4.0 for Windows, the \$99.95 file manager and viewer from the Central Point division of Symantec Corp., is a strange mutation. Central Point is billing it not as an upgrade to XTree for Windows but rather as a specially designed for Windows version of the popular DOS-based XTreeGold program.

What that means is that just about every keystroke combination from the DOS version also works in this Windows version. A toggle allows you to use traditional Windows File Manager-like commands if you would prefer to do so.

**Like the File
Manager or any**

of several other File Manager replacements, XTreeGold exists in order to help you keep track of, manage, and view all the files on all of your PC's disks and network drives. For basic file management—copying, moving, erasing, unerasing, archiving, and the like—it's as good as anything on the market.

New to this version are two features that can speed up your file management.

The first, SmartTabs, provides a way to save different views of file lists so that you can show deleted files only, or show files with the viewer open. The second feature, File Companions, is a useful add-on menu that appears in all Windows File Open and Save As dialog boxes. From the menu, one click allows you to copy, move, rename,

delete, compress, or view files, or to format a disk or activate XTreeGold's SmartFind search tool.

XTree Gold 4.0 includes viewers for over 40 file types, including 10 vector graphics formats. (These are the same viewers that you will find in Central Point's PC Tools.) In our experience, most of the viewers worked well, but some of the word processor viewers were surprisingly slow to scroll, and they yielded inaccurate output

Windows Utilities

Download Remote Files Quickly with HotDisk

BY CAROLE PATTON

If you're on the road a lot, you'll appreciate Smith Micro Software's \$99.95 HotDisk, Version 1.0. It's a telecommunications program that does one job very well: downloading files from a host machine via a modem. In an age of fatware and sloppy software, HotDisk is a marvel of minimalism.

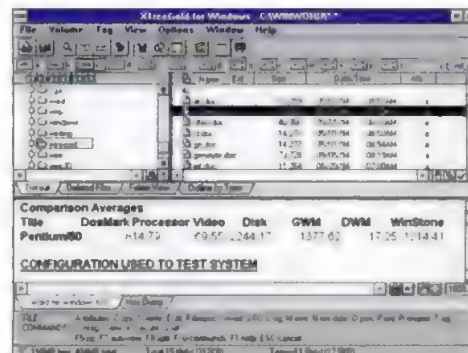
If access to remote files is all you want, you probably don't need a sophisticated remote-control package. Rather than taking control of another system, HotDisk finds and downloads the files you want. All the processing is done on your local machine. What's more, this program occupies a mere 2MB of hard disk space and loads a remarkably tiny (41K) terminate-and-stay-resident program that handles dial-ups and file transfers.

HotDisk allows you to start using your office's hard disks as virtual drives on your remote PC.

when we printed from them directly.

Will Microsoft's upcoming Windows 95 knock some of the wind out of the XTreeGold package? Perhaps, but since the program is already equipped to handle long filenames, it will most likely continue to prosper as long as overcrowded hard disks continue to exist.

► **XTreeGold 4.0 for Windows.** List price: \$99.95. Requires: 4MB RAM, 6MB hard disk space, Microsoft Windows



ON DISPLAY: *XTreeGold's viewer window automatically displays the file you've selected without having to open another application.*

dials back to a known location. If you manage a LAN or are normally on the host side of file transfers, HotDisk lets you configure access rights (read only, read and write, and so on) for individual users.

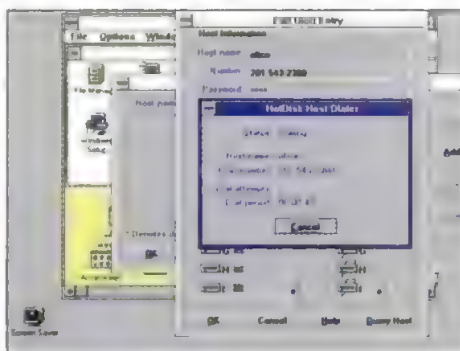
Although modem speeds of up to 115,200 bps are supported, make sure you have a high-speed UART in your PC or you use an internal modem; otherwise you won't get the throughput benefit. Also, remember that under Windows 3.11 the driver (COMM.DRV) won't support speeds anywhere near that high. If you pick a modem rate not supported by your communications driver, HotDisk will send out more data than your system can receive, resulting in data overflow.

In the world of do-it-all software for traveling executives, HotDisk is a welcome change that makes getting data easier and quicker.

► **HotDisk, Version 1.0.** List price: \$99.95. Requires: 640KB RAM, 2MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.1 or later. Smith Micro Software Inc., Aliso Viejo, California; 800-964-7674, 714-362-2345; fax, 714-362-2300. Circle 403 on reader service card

accessible at a moment's notice. HotDisk supports up to ten virtual drives, which you can map any way you want. If your office machine is on a network, you can even map to the network drives. HotDisk provides a list of all drives available at the host site.

HotDisk alphabetizes your



REMOTE ACCESS: *HotDisk reads remote disk drives as if they were on your computer.*

phone book and can auto-dial entries for your frequently used numbers. The program contains a reasonable degree of security, including dial-in password protection and a host dial-back routine, which verifies the caller and

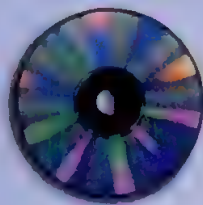
BACKUP ON CD!

Recordable CD Backup System



TAPE IS OUT.

- Tape is slow
- No random access
- One-year shelf life
- Too many different formats
- Reliable?

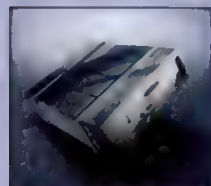


OPTICAL IS IN.

- Recordable CD is fast
- Random access
- Five-year shelf life
- CD-ROM standard format
- Very reliable

The CD has replaced the tape cassette in the music industry. And Recordable CDs are well on their way to replacing tape in the computer industry.

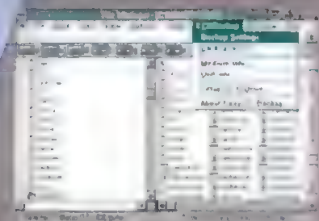
Introducing the new **Pinnacle RCD-1000™** - the best way to backup your data. Our Recordable CD System comes complete with backup software for **\$1995**. Each Recordable CD holds up to 680 Megabytes of fast random access data. RCD media is reliable with a five-year shelf life guaranteed. And inexpensive, only **\$29** per disk or **4 cents** per Megabyte. The Pinnacle RCD-1000™ is ideal for data archival, as well as creating and testing multimedia titles, even making your own music CD of custom tunes. The RCD is the best way to backup data since RCD media can be played back on most CD-ROM drives.



Pinnacle RCD-1000™ internal or external versions.

The new Pinnacle RCD-1000™ is a **double speed** multisession recorder and player. It supports ISO 9660, CD-XA, CDI and CD Red Book audio recording standards. The RCD-1000™ is equipped with a big 1 MB cache buffer that will ensure compatibility with most hard disk drive systems. Available in

The RCD-1000™ system comes complete with Pinnacle's easy-to-use software program and **backup utility** for Windows. Simply drag and drop files from your File Manager application to your RCD application window and in minutes you've mastered your own compact disc - from data backups to new information creations.



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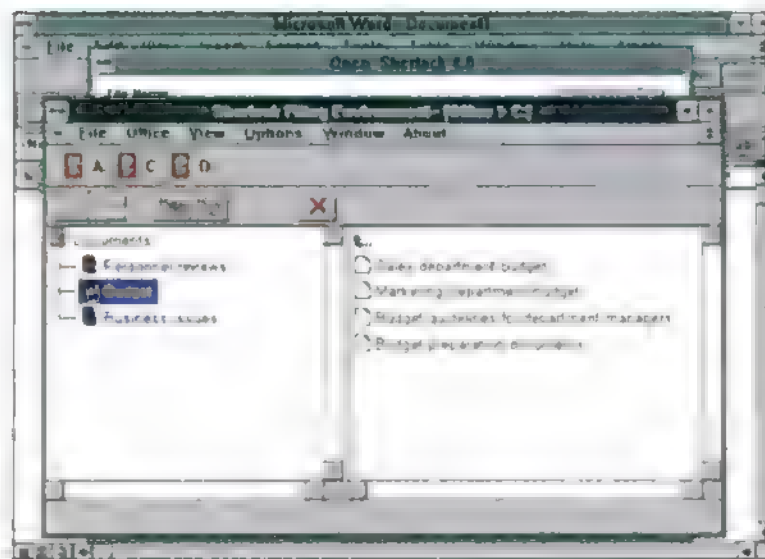


Document Management Sherlock Streamlines Windows' Workflow

BY DAVID HASKIN

Earlier versions of 2010 Software Corp.'s document management program Sherlock 4.0 (\$179) were frustratingly confusing. This latest release, however, has matured into an effective tool for individuals and workgroups to manage electronic documents. Sherlock is also available in workgroup-size ten-packs (\$695), but its focus is on the desktop: It doesn't try to be an enterprise-wide document management system.

Sherlock works by replacing an application's dialog boxes for saving and retrieving files with its own. In Sherlock's Save dialog box, you can provide a descriptive name with a maximum of 254 characters, as well as information such as the docu-



ORGANIZE: Sherlock's filing system consists of a series of folders that represent files on your system.

ment type and author.

Besides providing adequate space for file descriptions, you can also assign normal DOS file names to documents. This lets you find specific Sherlock-saved documents when you are look-

ing at a DOS directory. Previously, Sherlock would assign documents confusing and nondescriptive number-based names. When saving, Sherlock automatically indexes documents so that you can later

search based on content or on the information you entered in the Save dialog box.

The results of a search are displayed in a window; double-click on an entry to open that document. Buttons in the window's toolbar enable you to print the document or place its contents

into your currently active application. In addition, you can create a series of folders and subfolders for documents, corresponding to the directories and subdirectories that Sherlock uses for storing files. You can

move documents among folders and their related subdirectories by dragging and dropping in Sherlock's file management window.

Sherlock has several innovative features, such as a utility for importing batches of files into Sherlock. But that utility did not work in our tests, and 2010 Software could not explain the failure.

Yet for basic document management needs, Sherlock has become a highly usable and useful product. If your primary need is to keep track of a large number of files and you don't need more powerful document management capabilities, Sherlock is a good choice.

► **Sherlock.** List price: Single user, \$179; 10-user version, \$695. Requires: 2MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. 2010 Software Corp., Hasbrouck Heights, New Jersey; 800-952-2314, 201-288-7100; fax, 201-288-7274.

Circle 402 on reader service card.

Data Management Mining for Information Gold

BY DAVID HASKIN

Since not all information fits neatly into the structured fields of databases, we need programs like askSam for Windows, Version 2.0 (\$395), to help find information needles in haystacks of free-form text. The second version of this text-retrieval and data-management product simplifies collecting character-based information and helps add structure to that information.

Although askSam looks and acts like a word processor, each document actually is a record in a text database. This version of askSam makes it easier to designate sections of text as fields. You can search for all text entries that are bounded by any words or punctuation; for example, you can use askSam to find all instances of text between the word *subject* and the end of a sentence.

Putting together reports is easier because the report creation screen now includes a window listing all available fields; you create a report by dragging the field name from the window to the report generator.

askSam improved its ability to collect information from a variety of sources. It now includes an import filter for the CompuServe Information Manager so you can directly import e-mail and forum message threads. It also includes filters for the Nexis and Lexis on-line services.

This upgrade also has real hypertext capabilities: You can set up links to jump from one specific place to another. The destination can be in the same document or in another one.

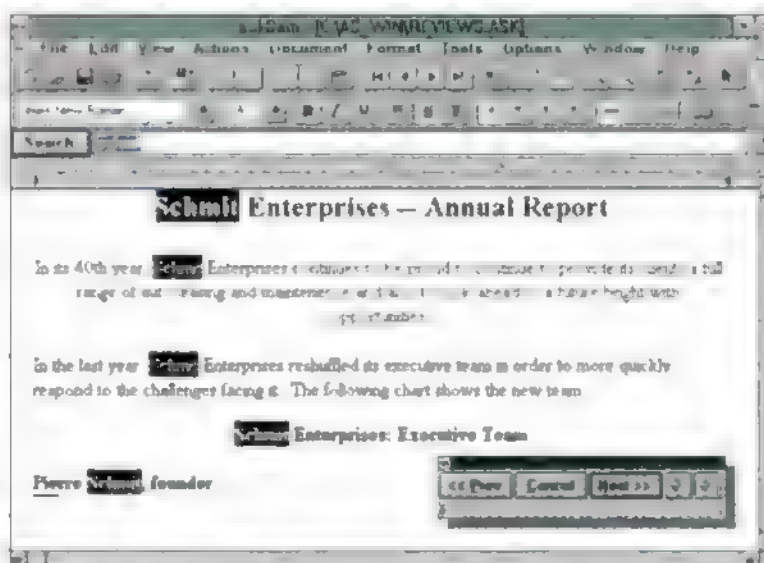
Another new feature is the ability to search across multiple databases. But you cannot append search results to existing askSam databases or save them as a new database. This would be a useful way to extract information from multiple databases to create a

conduct complex searches. The only way to save a set of search criteria is to include it in a report. The product also would be stronger if it included built-in scanner support and optical character recognition, but you can add those capabilities by purchasing a \$99 add-in module.

Useful textual information is like gold: You have to sift through a lot of ore before you find the valuable nuggets. For those who gather and manage text—and for those who must extract informational nuggets from it—askSam can be an invaluable tool.

► **askSam for Windows, Version 2.0.** List price: \$395. Requires: 4MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later. askSam Systems, Perry, Florida; 800-800-1997, 904-584-6590; fax, 904-584-7481.

Circle 401 on reader service card.



EASY PICKIN'S: After a search, askSam shows each text document with the search terms highlighted.

new body of information.

Also missing are database compression and the ability to save search criteria easily, a helpful feature if you repeatedly

A VIEW TO A KILL.



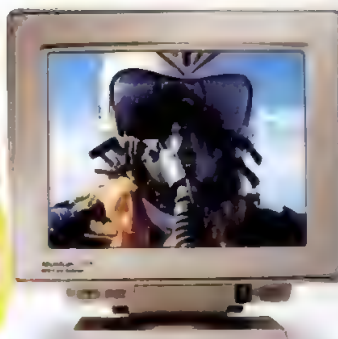
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■ Word Processing

WordExpress Balances Features with Price

BY J.W. OLSEN

If you think finding a do-it-all Windows word processor for under \$50 that occupies 5MB hard disk space is impossible, think again. MicroVision Development's \$49.95 WordExpress 1.0 manages this feat and even outdoes some of the high-priced competition. The only downside is that it lacks the ability to exchange documents with popular word processing programs.

WordExpress doesn't skimp on features. Included are: stylesheets, embedded graphics and tables, borders and shading, numbered lists and bullet lists, inserted fields, search and replace of text and format attributes, mail merge, envelope printing, a spell-checker and thesaurus (in optional multiple languages), and automatic hyphenation. Paragraphs can be assigned any of 10 outline levels, each automatically numbered in legal (1, 1.1, 1.1.1) or traditional outline (I, A, i, a) fashion. All of these features are detailed in a well-prepared manual.

Working with page layouts in WordExpress is easy and straightforward. Zooming in and out, fitting pages to windows, and switching between text and object modes is effortless even with multiple documents open simultaneously in different modes. You can rotate text and clip, crop, or rotate graphics. WordExpress offers seven basic graphics tools to produce rudimentary figures like circles and squares, as well as snap-to-grids and user-definable guides. And for the price, WordExpress offers a remarkably robust set of nearly three dozen templates.

What's left out? If you regularly exchange documents with others you will miss the ability to open and save files in the native

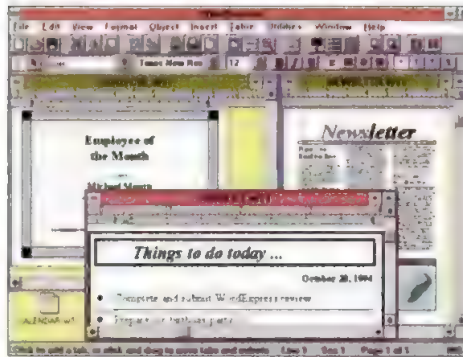
formats of other word processors. In addition to its own format, WordExpress currently supports only Rich Text Format, ASCII, and ANSI. This works well for simple documents, but for compound documents you're stranded.

Some features are sluggish and others are awkward to use. For example, to open the four supplied business card templates in

separate windows, you must click "new window" and "template" each time from the File Open dialog box. Also missing is OLE convenience when working with embedded objects.

Overall, however, this new kid on the Windows word processor block provides quite a bang for the buck. WordExpress is a natural for the budget conscious, as well as those with cramped lap-top hard disks. And it's ideal for anyone who won't skimp on the meat but can do without some of the gravy.

► **WordExpress 1.0.** List price: \$49.95. Requires: 4MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later. MicroVision Development Inc., Carlsbad, California; 800-242-4775 (orders only), 619-438-0305; fax, 619-438-7406. Circle 405 on reader service card



INSTANT ARTIST: WordExpress provides professional templates to jump-start your artistic talents.

■ Memory Management

QEMM Makes Memory More Manageable

BY BARRY BRENESAL

Managing and optimizing a PC's memory ranks right up there alongside cleaning the refrigerator and emptying the kitty litter box among America's least favorite pastimes. Yet with Quarterdeck's \$99.95 QEMM, Version 7.5, cleaning up the nooks and crannies of memory

usable memory was the priority in previous Quarterdeck efforts, QEMM, Version 7.5, puts on a prettier face. All the same, there's at least a bonus for Stacker 4.0 users. QEMM's new Stacker driver loads almost entirely into extended memory, freeing up an additional 8K to 32K of conventional memory.

Two major enhancements reflect Quarterdeck's perceived need to broaden product accessibility: QSETUP, QEMM's menu-driven interface, and Manifest, Quarterdeck's excellent diagnostic/reporting utility, make their Windows debut in this release. Identical to their DOS counterparts, they do an excellent job of letting you know what is going on inside your PC. In addition, QEMM now supports PCMCIA.

A new feature, QuickBoot, reinitializes your operating sys-

tem instead of warm-booting it everytime you hit Ctrl-Alt-Del. This saves several seconds whenever you need to restart Windows.

Another time-saver is the ability to make automatic backups of your ten most recent memory configurations. You no longer need to rerun OPTIMIZE every time you want to remove a device driver or TSR. On the other hand, Quarterdeck hasn't upgraded QSETUP to include this feature as yet. The only way to restore previous OPTIMIZE configurations is by typing OPTIMIZE /R at the command line.

QEMM has hitherto been regarded as the most efficient memory management system available but inferior in its ease of use to Qualitas's 386MAX. The new one-stop memory reconfiguration menus and QEMM's Windows debut should go a long way toward correcting that problem. At \$35, it's an upgrade many will perform.

► **QEMM, Version 7.5.** List price: \$99.95; upgrade, \$35. Requires: 1.5MB RAM, 3MB hard disk space. PC-DOS 3, 4, 5, or 6; MS-DOS 3, 4, 5 or 6; or DR DOS 6. Quarterdeck Office Systems Inc., Santa Monica, California; 310-392-9851; fax, 310-314-4217.

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DETAIL: QEMM's Manifest provides a look at the inner workings of your PC.

management can be a relatively brief, painless, and ultimately rewarding procedure, particularly for those who use Stacker disk-compression.

While eeking out additional

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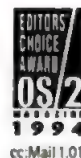
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PCs

Three Pentium Desktops That Set the Corporate Pace

BY WILLIAM P. FLANAGAN
AND BRIAN NADEL

With more than 200 distinct desktop computer brands available—each with at least three different processors and a staggering array of hard disk and monitor options—selecting the right one for your office needs might make finding a needle in a haystack seem comparatively easy.

Compare these three 90-MHz Pentium latecomers with those reviewed in this issue's "For Love or Money" review story. Each represents the latest in design and engineering, and each deserves to be on your short list of potential office PCs.

The Ares Multimedia Pro offers flexibility by giving access to all three major internal buses, while the DEC Celebris 590 is a great start for those who want to personalize their system's hardware and software. The IBM PC 750-P90 sets the pace in terms of performance and includes an excellent assortment of useful software.

ARES MULTIMEDIA PRO

The \$3,033 Ares Multimedia Pro sacrifices some performance to give buyers the extraordinary flexibility of using ISA, VL-Bus, and PCI bus cards. This any-bus design allows the Multimedia Pro to act as a bridge between VL-Bus and PCI bus architectures.

The Ares system, which is built around the Opti Dual-Bus motherboard design, takes full advantage of both local buses by using a VL-Bus-based disk controller and a PCI-based video card that uses the S3 Vision864 chip set.

The 90-MHz Multimedia Pro we tested was equipped with

16MB RAM, a 256K external cache, and a 528MB hard disk. The system's performance on the majority of our benchmark tests was close to or below the average of dedicated VL-Bus systems with the same processor. Our DOS-based benchmark test results were below the average of the other 90-MHz Pentium units evaluated in this issue; the system's Graphics WinMark 95 result was below the average for systems that used the S3 Vision864 chip set. The Disk WinMark 95 and Winstone 95, Version 1.0, scores were about average for this processor class. On the other hand, full-bore performance is not the point of a system that can use just about any ISA, VL-Bus, or PCI peripheral device on the market.

In addition, the Multimedia



THREE-OF-A-KIND: IBM's PC 750-P90 combines top-notch performance and design flexibility with an array of excellent software.

Pro includes interesting and useful sound and telephony features that will quickly come to be expected in today's high-end system. The Multimedia Pro's integrated telephony system is based on its 14,400-bit-per-second modem, which allows it to oper-



EITHER WHICH WAY: The Ares Multimedia Pro goes either way—VL-Bus or PCI.

ate as a fax machine and an answering machine and support multiple mailboxes. This allows the user to save and log all faxes and messages, both sent and received. A trial subscription to America Online is also included with the system.

The unit's price tag of \$3,033 falls in the general range for this level of equipment. If flexibility and multimedia options are more important to you than performance, you should certainly take a look at the Ares Multimedia Pro.

DEC CELEBRIS 590

The \$3,548 DEC Celebris 590 is a curious system that offers all the promise of the 90-MHz Pentium processor, but includes few of the features usually associated with a high-end machine. It is, however, a sound foundation upon which an experienced user can build a system customized to his or her own needs.

The lack of a CD-ROM drive prohibits the use of the majority of multimedia packages; thus, the addition of an optional CD-ROM drive is strongly suggested. And, unlike other companies that bundle a number of software titles with their systems

(useful or not), Digital includes little beyond DOS, Windows, and power-management utilities.

What the Celebris lacks in software, however, it makes up for in system design. Two handles on the side of the unit allow for tool-free access to one of the

PC industry's most integrated motherboard designs. It includes an S3 Vision864 video chip set and 4 SIMM banks, as well as I/O circuitry and a floppy and hard disk controller. The slimline case accommodates a motherboard riser card that offers two shared PCI or ISA slots. Both slots were unobstructed, but there was only one free drive bay, which would probably be used for a CD-

ROM drive, leaving no further room for internal storage or tape backup.

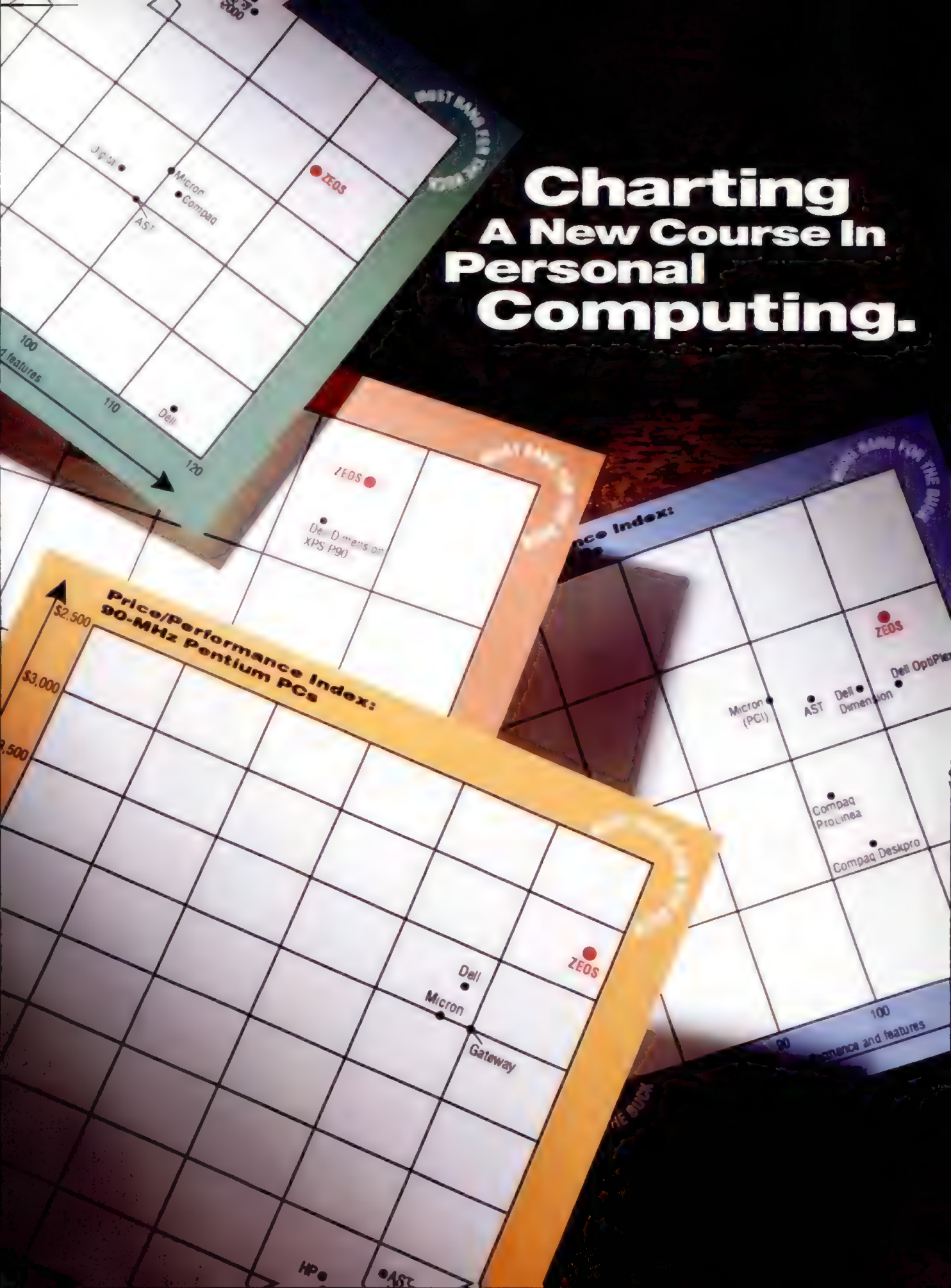
The system we tested costs \$3,548 and came equipped with 16MB RAM, a 256K external cache, a 540MB hard disk, and a 15-inch monitor. On our benchmark tests the Celebris 590 performed at a level you would expect from a 90-MHz Pentium PC. The system's scores on our DOS-based tests were on a par with other 90-MHz Pentiums, and its Graphics WinMark 95 result was right in line with the overall average. The Disk WinMark95 and CPUmark16 scores were slightly above average.

The DEC Celebris 590 is a highly integrated system with competitive performance, but the package lacks a lot of the software that many expect in a higher-end system.

IBM PC 750-P90

In rethinking its desktop strategy, IBM has sought to achieve the impossible: retaining those who have invested in its proprietary Micro Channel bus design while attracting a whole new class of PC buyers who are interested in performance and industry standard designs. IBM's

Charting A New Course In Personal Computing.



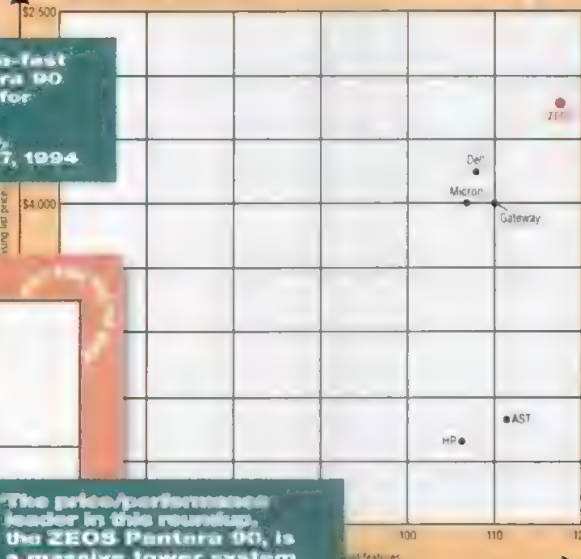


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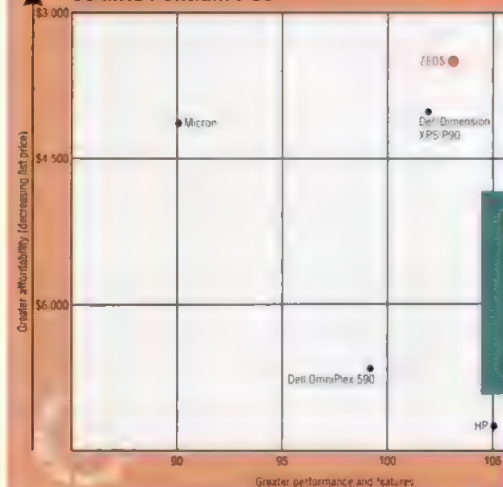
"In this roundup of ultra-fast PCs, the ZEOS Pantera 90 offers the most bang for the buck."

PC Magazine,
September 27, 1994

Price/Performance Index:
90-MHz Pentium PCs



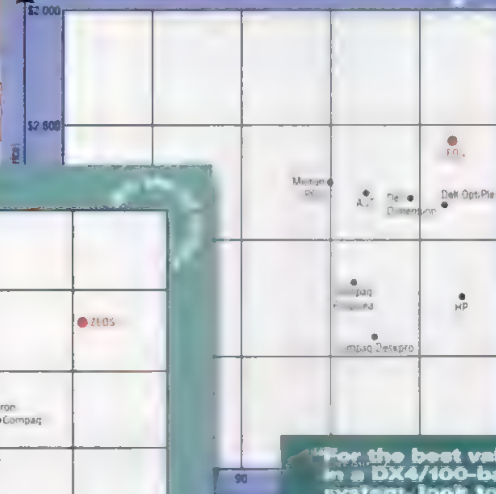
Price/Performance Index:
90-MHz Pentium PCs



"The price/performance leader in this roundup, the ZEOS Pantera 90, is a massive lower system with nearly unlimited expansion room and competitive performance."

PC Magazine,
June 20, 1994

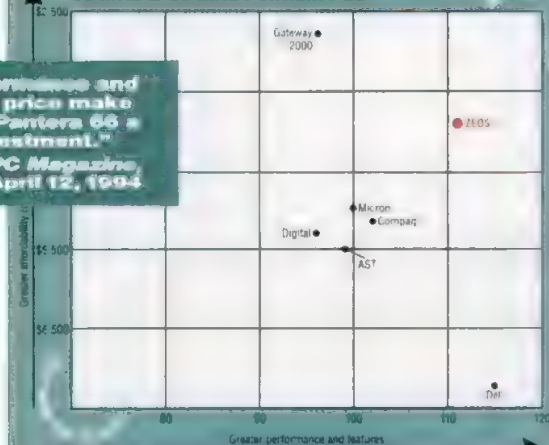
Price/Performance Index:
100-MHz DX4 PCs



"Solid performance and affordable price make the ZEOS Pantera 66 a quality investment."

PC Magazine,
April 12, 1994

Price/Performance Index:
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All Pantera packages include Microsoft DOS 6.2 and Windows for Workgroups 3.11. In addition, packages 3 and 4 include Lotus SmartSuite—1-2-3, Ami Pro, Freelance Graphics, Organizer and Approach.

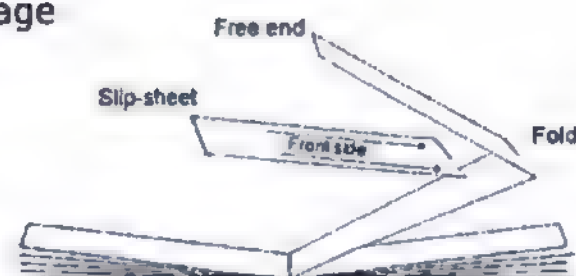
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Foldout slip-sheet



Inverted Foldout slip-sheet

Folded edge of the page

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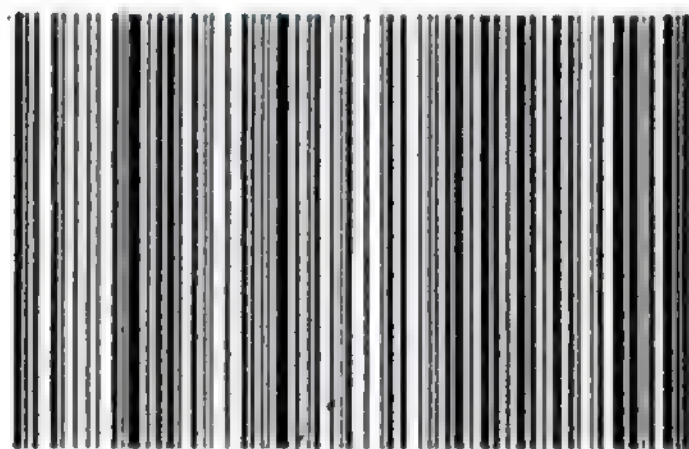
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Pentium-90
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486DX2-66
March 1994

Time after time, the ZEOS Pantera has been tested against the competition, repeatedly beating all others hands down. In *PC Magazine's* price and performance comparisons of technologically-advanced systems from primary computer companies, ZEOS is the unbeatable value.

Unmatched in its success, the Pantera is earning award after award—month after month. To date, the Pantera has received an unparalleled 22 top honors from leading industry publications! Experts agree that the ZEOS Pantera provides you with the biggest bang for your buck.

PC World reported: "The ZEOS Pantera 90 is the ultimate Power Desktop. It's lightning fast, beautifully configured, and priced right. That's what power Best Buy is all about."

PC/Computing said: "Rocket-fast performance and a great price make this our favorite Pentium of the lot."

As *Computer Shopper* said: "ZEOS set the standard."

Continuing with the ZEOS tradition of providing you with top performance, unwavering reliability and exceptional value, the ZEOS Pantera is charting a new course in personal computing.

Chart-Topping Performance

The Pantera—based on Intel's 486, DX4 and Pentium processors—is at the top of the performance charts, breaking records and beating all others. Why? Superior engineering built into each Pantera—beginning with a ZEOS-designed motherboard created

specifically to take full advantage of the latest technological advancements. The motherboard is stocked with exceptional features such as an on-board PCI Local Bus IDE Controller supporting up to four IDE devices. For the fastest video performance, every Pantera comes with



a Diamond Stealth 64-bit PCI video card with 1MB DRAM *standard*.

The results are unparalleled. "Mark a new high on the performance chart!"

PC World said the Pentium-66 and Pentium-90 Pantera PCs were "the fastest system(s) ever tested." *PC World* also awarded the Pantera DX4-100 a Power Best Buy in October after it outperformed all other DX4 machines, *and* was as fast as many Pentium-90 PCs!

The Pantera 66MHz and 90MHz also received the highest scores in all benchmark tests run by *Windows Sources* too. "The clear winner is the ZEOS Pantera. Its scores were the best across the board."

All Points Covered

The Pantera is a first-rate example of ZEOS' commitment to provide you with an excellent value on an award-winning machine that will increase your productivity. With all the extras, options, and 100% compatibility with all major operating systems, you can't go wrong.

Many of our most popular money-saving Pantera packages are ready to ship *the same day you order*. We also give you the option to custom-design a system to your exact computing needs.

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486DX2-66 \$1845
Pentium-60 \$2145

Package #2:

- 8MB RAM
- 528MB local bus IDE hard drive
- 2X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64-bit PCI local bus SVGA graphics card with 1MB DRAM
- SVGA color monitor
- MS-DOS, Windows for Workgroups, Microsoft Mouse



486DX2-66 \$2295

Pentium-60 \$2595

Top Gun:

The above system modified to include:

- 256K SRAM cache
- Diamond Stealth 64-bit PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor upgrade
- 14.4/14.4 send/receive fax modem
- Lotus SmartSuite



486SX-33 \$1195

Package #1:

- 4MB RAM, 128K SRAM cache
- 214MB hard drive
- 3.5" 1.44MB floppy drive
- VESA local bus SVGA color video
- SVGA color monitor
- MS-DOS, Windows for Workgroups, Microsoft Mouse



DX4-100 \$2840

Editors' 100:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive
- 2X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64-bit PCI local bus graphics card with 2MB VRAM upgrade
- 15" SVGA color monitor
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Lotus SmartSuite



Pentium-66 \$2895
Pentium-90 \$3045

Editors' Choice:

The above system modified to include:

- 10-bay vertical case



DX4-100 \$3095

Package #3:

- 8MB RAM
- 350MB IDE hard drive
- External 3.5" 1.44MB floppy drive
- STN color VGA 7.8" display
- Custom carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- Lotus Organizer
- 7.8" x 10.2" x 1.7"; 3.9 lbs.



Pentium-66 \$3418
Pentium-90 \$3568

Best MM:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive
- 2X CD-ROM drive, 3.5" 1.44MB FDD
- 16-bit sound card, stereo speakers
- Diamond Stealth 64-bit PCI local bus graphics card with 2MB VRAM upgrade
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Lotus SmartSuite

Pentium-90 \$4295

Best MM Supreme:

The above system modified to include:

- 24MB RAM
- 1GB local bus IDE hard drive
- Altec Lansing high-power speakers



DX4-100 \$3295

Package #3:

- 8MB RAM
- 350MB IDE hard drive
- Internal 3.5" 1.44MB floppy drive
- Dual-scan color VGA 10.3" display
- Custom carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- Lotus Organizer
- 8.9" x 11.7" x 1.9"; 6.3 lbs.

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(A sampling of our *Computers Now!* packages is shown at left.)

2 For same-day shipping, call ZEOS at 800-554-7172 before 1 p.m.

Central Time, Monday-Friday.

3 Upon credit approval, we'll ship your system *the same day you order!*

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If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.*

Need A Bigger Monitor?

We can upgrade your *Computers Now!* desktop or vertical system with a larger monitor—and still ship it the same day you order!*

800-554-7172

24 Hours a Day



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*Orders must be for *Computers Now!* configurations, we're limited just a sampling here. Since we continuously update this list of configurations, please call to confirm your system is on the list. This offer is good only as long as these pre-built systems remain in stock. Other ZEOS systems and custom configurations may take slightly longer—about a week. All orders are subject to credit approval. Monitor upgrades available on all desktop *Computers Now!* packages. Orders must be received by 1 p.m. Central Time, M-F.

Purchase orders are subject to approval. Business leasing programs available. Lease prices based on a 36-month lease, 10% purchase option. All prices, specifications and availability are subject to change without notice; call to confirm these and warranty details. Prices do not include shipping. Novell compatibility is Developer Tested Only. Novell makes no warranty with respect to this product. All products and company names are trademarks or registered trademarks of their respective holders. Intel Inside and Pentium Processor logos are trademarks of Intel Corporation. ZEOS is a registered trademark. *Computers Now!* is a registered service mark. Business Analysis, Promise and ZEOS Meridian are trademarks of ZEOS International Ltd. © 1994 ZEOS International Ltd. 1380 Industrial Blvd. Minneapolis, MN 55413 USA. ZEOS is a publicly traded company. (NASDAQ symbol: ZEOS) P&H-PCM-9413A

CIRCLE 155 ON READER SERVICE CARD.

First Looks

Pentium PCs

CONTINUED FROM PAGE 48

\$4,549 PC 750-P90 combines IBM's SelectaBus flexible architecture with top-notch performance, making the PC 750-P90 an obvious office choice.

IBM engineers started with what is arguably the most adaptable motherboard available today. Instead of combining multiple buses in one system—as does the Ares Multimedia Pro—IBM's design places the bus infrastructure on a removable riser card. At present, the



STARTER: The DEC Celebris 590 is an excellent system for those who want to customize their own PC.



Benchmark Tests: 90-MHz Pentium Desktop PCs

These three 90-MHz Pentium PCs offer a wide range of performance results, from the flexible but underachieving Ares Multimedia Pro to the well-integrated Celebris 590 from Digital Equipment Corp. Using Winstone 95 as a gauge of a PC's ability to efficiently work with the most popular applications, the IBM PC 750-

P90 is one of the most powerful systems we've ever tested.

We used PC Magazine Labs' PC Bench, Version 9.0, WinBench 95, Version 1.0, and Winstone 95, Version 1.0 to measure the performance of these desktop PCs. All were equipped with 90-MHz Pentium CPUs and 16MB of system memory.

	Winstone 95 (Score)	Graphics WinMark 95 (Millions of pixels per second)	Disk WinMark 95 (Score)	WinMark (Score)	CPUBench (Score)	DOS Video (Score)	DOS Disk (Score)
Ares Multimedia Pro	78	9.5	589	771	176	1,624	622
DEC Celebris 590	98	11.7	600	923	191	4,085	621
IBM PC 750-P90	143	12.0	818	965	195	3,548	747
Pentium/90 average	113	11.7	592	870	186	3,955	614

combo ISA/PCI riser is available, but by February 1995, IBM will introduce an ISA/Micro Channel riser card. The bottom line is that the PC 750-P90 has all the bus bases covered, because owners will be able to convert the system's bus architecture at any time.

This unparalleled flexibility does not come at the cost of performance because the PCI-based system, which came equipped with a 90-MHz Pentium processor, 256K of external cache, a 720MB hard disk, and 16MB of system memory, was the second most powerful PC we've ever tested. With a

Winstone 95 score of 143, this is a PC that will be able to handle just about any task you throw at it. On the other hand, the PC 750-P90's DOS scores were a little above average on disk access and a little below average on video.

IBM's 750 series of PCs stands out in terms of software as well. In addition to Windows for Workgroups (OS/2 is an optional alternative), IBM includes Binar's AnyView utility, which lets you move among video resolutions and color depths at will without restarting Windows; and DiagSoft's QAPLUS, which allows remote

interrogation and configuration changes via modem. The PC 750-P90 also offers IBM's Netfinity package of LAN administration software.

The design of the PC 750-P90's system case is unique as well. While a lockable cover slides horizontally to close off the PC's floppy disk and CD-ROM drives, the lock would likely be covered by the monitor's base.

The system's price of \$4,549 compares well with other high-end PCs, particularly because it includes a superb 17-inch monitor. Based on its design flexibility, performance, and thorough package of software, the IBM PC 750-P90 is a triple play.

► **Ares Multimedia Pro.** List price: With Pentium/90 CPU, 16MB RAM, 256K external cache, 528MB hard disk, 15-inch monitor, \$3,033. Ares Microdevelopment, Farmington Hills, Michigan; 800-322-3200, 810-473-0808; fax, 810-473-4450.

Circle 429 on reader service card.

► **DEC Celebris 590.** List price: With Pentium/90 CPU, 16MB RAM, 256K external cache, 540MB hard disk, 15-inch monitor, \$3,548. Digital Equipment Corp., Maynard, Massachusetts; 800-722-9332.

Circle 430 on reader service card.

► **IBM PC 750-P90.** List price: With Pentium/90 CPU, 16MB RAM, 256K external cache, 720MB hard disk, \$4,549. IBM Personal Computer Co., Somers, New York; 800-426-2968.

Circle 431 on reader service card.

■ Compaq Presario: The At-Home PC

The highly integrated, all-in-one chassis of the Compaq Presario CDS 520 makes it the perfect system for the space-constrained among us. But beyond its compact packaging, the Presario also includes some of the most advanced telephony features available, as well as a good variety of bundled software. Overall, the Presario is as much a home appliance as PC.

For the new user, system configuration is made easy by a quick setup guide and demonstration video. The Presario's monitor-plus-system-unit now includes speakers, so only the keyboard and mouse are separated from the system.

A communications device as well as a computer, the Presario has a built-in 14,400-bps data/fax modem. This allows it to act as a home communications center. The Presario can send and receive faxes, operate as a digital answering machine, or, with the integrated microphone, act as a full-featured telephone (with surprising clarity).

At \$1,957 for a system built around the AMD 486SX2/66 processor with 8MB RAM, a 422MB hard disk, and a 15-inch integrated monitor, the Presario CDS 520 is priced for the home, but offers Windows performance below the average of the Intel DX2/66 systems tested. But performance aside, with software such as Quicken (for home and personal finance) included, as well as a number of children's titles and telephony options, the Presario is both fun and functional.

With its unequalled level of system integration, the Presario CDS 520 stands alone in the home PC market, and will likely be a valued member of the family.—WPF



■ Multifunction Devices

Three-in-One Devices from Canon and Ricoh

BY ALFRED POOR

In addition to a computer, small office necessities include a printer, photocopying machine, fax machine, and quite often an answering machine or voice mail system. If you're losing the battle for desk space to all these devices, relief is on the way: The first true multipurpose peripherals have arrived.

Although neither the laser printer-based Ricoh MV715 nor the ink jet-based Canon Faxphone B170 can do it all, the two represent design extremes in the melding of phone, fax, and printer. While the \$5,995 Ricoh outperforms the \$1,695 Canon multipurpose system, they each offer all-in-one convenience.

RICOH MV715

The \$5,995 Ricoh MV715 is the Rolls Royce of multifunction devices. A digital photocopier at heart, it can handle a range of enlargement and reduction options and can accommodate paper sizes up to 11 by 17 inches in its two 250-sheet paper trays. An automatic document feeder and duplex printing capability (two-sided copies) are available as options, though they are expensive add-ons.

Since the unit can scan documents for copying, it is simple, with a fax modem, to transmit those images as faxes. You can also enjoy the added benefit of receiving incoming fax messages on the same plain-paper, laser print engine used by the copier and printer.

The Ricoh connects to your PC through a parallel or serial port interface, providing PCL 5 print emulation; Adobe PostScript is available as an option. The end result is a single unit that fulfills the roles of copier,

fax machine, and printer. There is even an optional three-bin sorter that can route output from the three functions to separate bins, so incoming faxes don't get mixed up with your photocopies or printed documents.



ALL-IN-ONE: The Ricoh MV715 (left) and Canon B170 (right) combine the abilities of printer, fax, and copier to conserve desktop real estate.

The printer features 300 dot-per-inch resolution and produces good quality output, with solid, crisp black areas. The printer is rated at 10 pages per minute, but our evaluation unit had the optional \$1,200 bin sorter, which dropped the performance to just 3.2 ppm for text in PCL 5 and 2.9 ppm in PostScript mode. If you plan to rely on this unit as a high-speed printer, you may want to forgo the bin sorter.

While the MV715 does a lot, there are still some more things it cannot do. For example, there is no way to fax directly from your computer unless you use a dedicated fax modem; you must first print it on the printer, then manually send it as a fax. And you can't scan a document from the unit to your printer.

This multifunction package costs a lot compared with standalone workgroup printers, but less than separate components of equivalent quality. It may only be a matter of time before most workgroup printers combine similar functions as the

Ricoh MV715, either as add-ons or integrated.

CANON FAXPHONE B170

If you're looking for an all-in-one solution and the Ricoh MV715 is too expensive, the \$1,695 Faxphone B170 from Canon may be just what you need.

The unit looks like a typical standalone fax machine, but on its side there are phone line jacks and a parallel port. Inside is a 360-dpi ink jet print engine, based on Canon's Bubble-Jet technology, that comes with IBM Proprinter X-24E and Epson LQ-510 emulation modes.

The printer produces near-laser-quality output on plain paper. It has three quality modes: high-speed, high-quality,

and super-high-quality. In our tests, it produced 3.2 ppm, 2.7 ppm, and 1.9 ppm, respectively, in these modes. The high-speed mode was excellent for text, and presented a good balance of speed and quality; it will likely be most appropriate for typical business printing.

The biggest drawback of the B170 is that it cannot be active in all modes at once. It is always ready to receive incoming faxes, but in print mode it can't be used to send faxes. Like the Ricoh unit, the Canon Faxphone can't send faxes directly from the PC; you must print a document first, then feed it through the fax machine part of the B170.

The B170's biggest headaches are its phone answering machine's poor sound quality and its cryptic front-panel controls, which require some study before you can successfully record or change your answering message. We suspect that many will choose to forgo this extension of the system and buy the B160 unit instead, which costs \$100 less and doesn't include the phone answering system.

With a list price of \$1,695, the B170 costs no more than a separate plain paper fax machine, answering machine, and ink jet printer. But with the B170 you get the savings in space, supplies, and convenience.

For a small office, either of these multipurpose devices could be the basis for printing, faxing, and copying.

► **Canon Faxphone.** List price: B160, \$1595; B170, \$1,695. Canon USA Inc., Lake Success, New York; 800-652-2666, 516-328-5000.

Circle 416 on reader service card.

► **Ricoh MV715.** List price: \$5,995; printer interface, \$695; PostScript option, \$700; base with two additional paper trays, \$1,195; duplexing unit, \$595. Ricoh Corp., West Caldwell, New Jersey; 800-637-4264, 201-882-2000; fax, 201-882-2506.

Circle 417 on reader service card

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The training begins right out of the box with a free *Learn Paradox for Windows Today!* video to teach you all you need to know about getting started with Paradox 5.0 for Windows. And act now, because this offer is only good from October 15 to December 31, 1994, so call Borland or your local dealer today!

CIRCLE 287 ON READER SERVICE CARD

*\$99.95 for existing owners of Paradox for DOS or Windows after \$30.00 manufacturer's rebate; dealer prices may vary.

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New Sidekick simplifies your life!

Sidekick is the all-in-one personal organizer that's so fast, functional, and friendly, it helps you stay on top of everything you've got going on: your calendar, your address book, your to-do lists—you're never more than a mouse-click away from your vital information.



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Borland



■ PCMCIA

NovaModem Gets the Word Out in Any Form

BY MIKE HOGAN

Not only does word travel fast these days, it also travels in many different forms. If you can't afford to be out of touch, NovaLink Technologies' \$249 NovaModem 144, a combination data/fax modem and pager on a PCMCIA card, will help you remain connected regardless of where you are.

Insert the NovaModem into a PCMCIA Type II slot on your notebook and you have a fully functioning office communications center that you can carry in your briefcase and can set up anywhere there is a phone line. You can also opt for the \$99 cellular connection option.

The Rockwell 96V24/144ACL chip set is the heart of the NovaModem 144, allowing the card to send and receive faxes, e-mail messages, or data files at a maximum throughput of 14.4 kilobits per second (Kbps). But under ideal line conditions, the NovaModem's V.42, V.42bis, and MNP 5 data compression/error correction algorithms can push data transfer rates to 57.6 Kbps. The card also uses MNP 10 to improve the quality and reliability of wireless transmissions.

The card comes with all the cables you'll need to connect, as well as Smith Micro's QuickLink Message Center data/fax/voice messaging software and Fourth Wave Software's WinBeep Plus 2.0 for sending pages. The NovaModem can upload a numeric page or alphanumeric message to any paging network supporting the TAP interface, including SkyTel, PageNet, PageMart, and MobileComm. While the NovaModem does not receive pages, NovaLink will introduce a product capable of two-way paging, called NovaPack 144, by the end of the year.

PCMCIA PAINS

Theoretically, you should be able to load NovaModem's communications software, plug the card in, and be up and running in 20 minutes. Unfortunately, the state of the PCMCIA standard is such that it can take hours before you can send a fax or page. Installing the QuickLink Message Center was straightforward, except that it prompts you to replace your Windows communications driver with its own—a suggestion the NovaLink manual overrules. The bundled WinBeep Plus paging software loads more cleanly.

You may encounter inexplicable conflicts—as we did—between your portable's card and socket services and the communications software's installation routine. For its part, the NovaModem 144 lived up to the PCMCIA promise on several

different portables once these conflicts were resolved. Particularly helpful was NovaLink's user manual, which provides complete explanations and often illustrated examples of



COMMUNICATIONS COMBO: The NovaModem 144 combines the functions of a data/fax modem with a pager.

modem hardware and communications software.

The NovaModem draws very little power and it can be programmed to go to sleep when not in use yet be able to wake up

to answer a telephone call. This unusual flexibility lets you turn your notebook into a communications server that will wake up and record a phone call, receive a fax, or e-mail a message for you anywhere you can plug into an analog line or connect via a cellular phone. Unfortunately, the NovaModem, like other PCMCIA modems, can't handle digital PBX switchboards.

Its limitations aside, NovaModem 144 is still one of the most convenient and effective ways to keep in touch when away from the office.

► **NovaModem 144.** List price: \$249. Requires: 4MB of RAM, 6MB hard disk space, Type II PC-

CIA slot, Microsoft Windows 3.1 or later. NovaLink Technologies, Fremont, California; 800-668-2546, 510-249-9777; fax, 510-249-9666.

Circle 418 on reader service card

■ Voice

Capture Your Thoughts

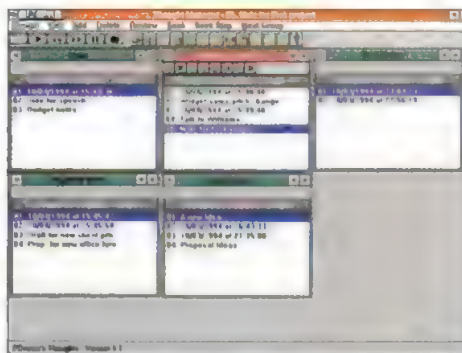
BY JONATHAN MATZKIN

The missing link in business audio has been software that naturally integrates voice capabilities into your work routine. Thoughts (\$79), from PCvoice, makes verbal notetaking a part of your Windows desktop, and has the potential to make it a natural part of your work day.

Thoughts places a button to activate the recorder in the top-left corner of your screen. Click on it to open the Thought Collector window, where you can record a note, then file it in any of up to 20 groups.

Since Thoughts is an OLE 1.0 server, you then can drag and

drop a voice note from the Thought Collector into compatible documents. In our experience, drag-and-drop worked fine with Word 2.0, but Excel 5.0



TALK IT THROUGH: Thoughts lets you organize, edit, and rearrange your verbal memos.

required that notes be manually pasted into cells.

In addition to the Thought

Collector, Thoughts offers useful .WAV file recording, editing, transcription, and management capabilities in its Thought Manager screen. You can easily edit a .WAV file, for instance, by recording an insertion anywhere in the target file. But make sure that the voice note has the same sampling rate as the target file, or it will sound garbled.

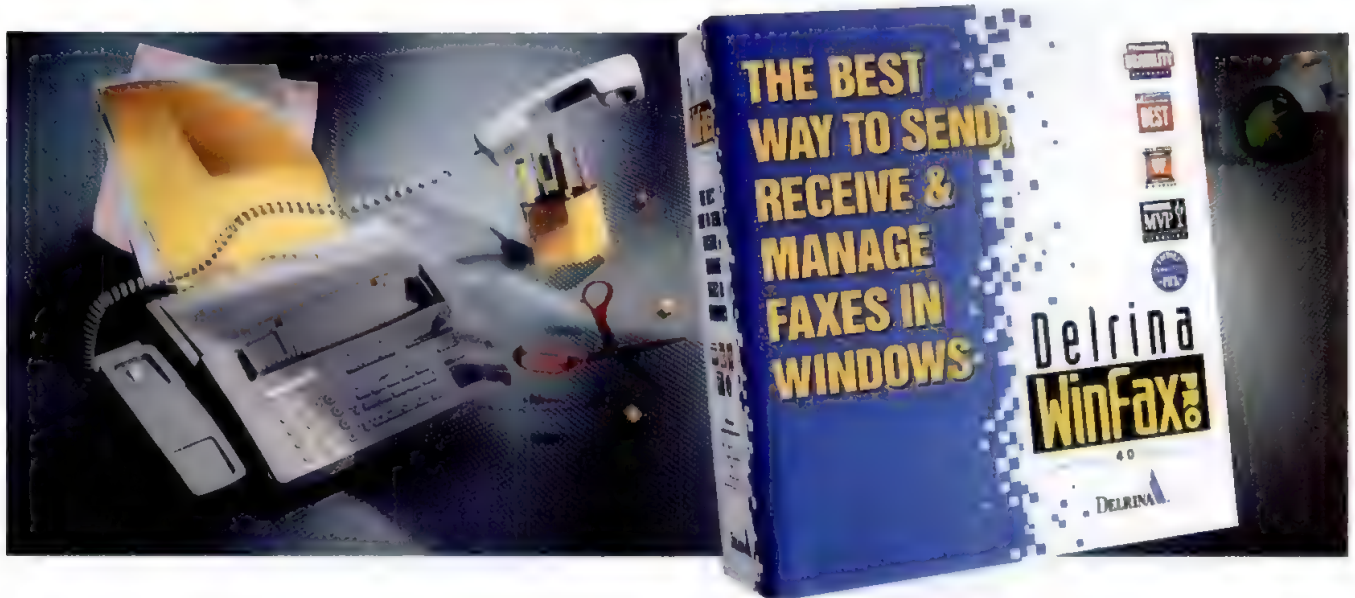
Nonetheless, Thoughts gives you the tools to make voice memos a practical part of your work environment.

► **Thoughts, Version 1.1.** List price: \$79. Requires: 4MB RAM, 1MB hard disk space, Microsoft Windows 3.1 or later, Windows 3.1-compatible sound device with microphone. PCvoice Inc.,

Roswell, Georgia; 404-343-8201; fax, 404-442-3156.

Circle 419 on reader service card

Introducing Delrina WinFax PRO™ 4.0. You'll wonder how you ever faxed without it.



Meet the fastest, easiest, most convenient way ever to handle all your faxing – new Delrina WinFax PRO™ 4.0, the latest version of the best-selling fax software in the world. The only one that combines the advanced faxing features you need with astonishing new ease and usability.

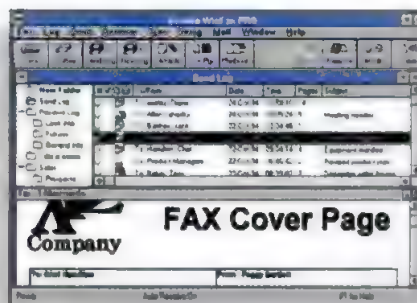
"The best fax package there is."

That's what *PC/Computing* said about version 3.0. And now we've made it even better.

Starting with the revolutionary new streamlined interface that makes it simpler than ever to do anything you'd do with a fax machine, and a lot more. Like sending faxes directly from within any Windows application as easily as you'd print. Or organizing sent and received faxes in convenient

folders. Or converting faxes into word processing documents with OCR.

There's added convenience with dozens of ready-to-use cover pages. Fax phonebooks that are drag-and-drop simple. And improved fax annotation tools that even let you add your signature.



Based on extensive usability testing, the new customizable interface includes folders for organizing sent and received faxes.

Don't try this with a fax machine.

Imagine faxing, not just an image of a document, but the actual file itself*, so it's ready to be used in an application. Imagine sending a single document that is automatically faxed to some people and e-mailed to others.

Now imagine you're on the road, and WinFax PRO automatically forwards faxes to you. Or lets you retrieve faxes sent to your regular fax number*. And there's more.

Get new Delrina WinFax PRO 4.0 today and put faxing where it really belongs – on your PC. Call now for information or to upgrade from WinFax PRO or WinFax LITE™. Or see your local dealer to upgrade immediately.

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*Requires Class 1 modem.

CIRCLE 250 ON READER SERVICE CARD

■ Video

Making Movies with VideoDirector

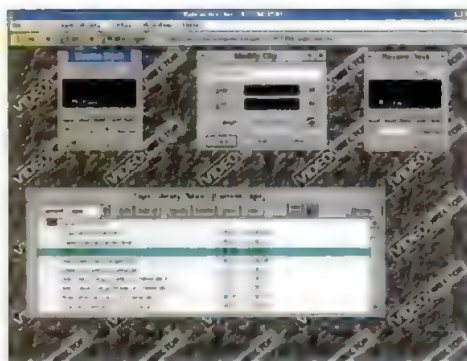
BY BILL MACHRONE

Two of the major consumer technologies of the last decade just pulled closer together. With the help of your PC, you can now edit videotape that you've shot with your camcorder.

VideoDirector 2.0 for Windows, from Gold Disk, works within the limitations of standard consumer camcorders and VCRs while exploiting the strengths of the PC as a controller for video playback and recording. The result is an enormous amount of flexibility in editing video and adding special effects. The \$199.95 program is neither a digital video editor nor is it frame accurate, but when used with a camcorder's tape counter, VideoDirector can produce excellent videotapes. It can even help you get a handle on your assorted videotapes by archiving the contents.

STORYBOARD YOUR VIDEO

Just as you don't put every photo you take into an album, you don't necessarily want to show all the tape you shoot. You may also want to produce your own videos, complete with titles, scenes, music, and voice-overs. With VideoDirector, you play the raw videotape (or videotapes) in the camcorder and



MOVE: VideoDirector uses your PC to control two video decks to arrange video clips into a movie.

electronically mark the start and end points for all the scenes, developing a storyboard progression of the scenes you want to use in an on-screen log window. VideoDirector does the rest: The resulting sequence of video clips is played back by your camcorder and recorded by your VCR (see illustration, below).

The most innovative feature of VideoDirector is Gold Disk's proprietary SmartCable, which connects the PC to the playback camcorder and the recording VCR deck. One end of the cable connects to your PC's serial port; another plugs into your camcorder's Control-L port, thus allowing the PC to control the camcorder. SmartCable's use of the Control-L port's bidirectional protocol allows VideoDirector to send tape counter information and various status codes from the camcorder to the PC, providing a fine degree of control over where a scene begins and ends.

The third end of the cable has an infrared window that sits in front of your VCR and controls it as if the cable contained an infrared remote-control device. The SmartCable can learn infrared commands, so even the most obscure VCR can be used as a recording deck.

Because you are not digitizing the video source material on your hard disk, neither the PC's hard disk nor its processor are limits to your creativity. For example, compressed video occupies about 9MB of hard disk space per minute of tape and requires a high-end PC with video hardware to display 30 frames per second. In fact, our work with VideoDirector was done with a 486SX/33 notebook PC with good results.

While VideoDirector doesn't require a video capture board, having one will give you more flexibility and creative control over the final product. For example, with a capture board in your PC, you can run the output from your camcorder to your PC's screen instead of a television. You can also capture freeze-frames from your scenes and use them as icons, which VideoDirector calls Picons (for picture icons), for transitions between scenes. For those who don't have a capture board installed, VideoDirector comes with a comprehensive library of generic Picons. At any time, you can add animation or graphical elements that are in any of a number of popular formats.

CREATIVE CONTROL

The first step in creating a video is to go through your collection

of relevant videotape and log the contents. Next, select the scenes you want from the logged tape and drag them into the Event Window in the order you want them to appear on your finished tape. If you've used Picons, you drag them instead. The Event Window becomes your storyboard, giving you a nice graphical display of how the video will unfold. You can arrange the scenes in any order that you want and preview them if you have forgotten their exact contents.

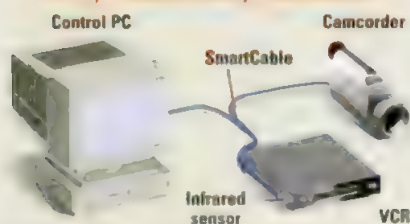
If you have a sound card with an on-board mixer in your system, VideoDirector can use it to overlay sound or mix music under your audio track. It lets you select wave, MIDI, or CD inputs as events in the Event Window, but if you want sound to fade in and out, you'll have to use the mixer's slider controls or record a macro to create the effect.

THE FINAL ELEMENT

As a final element in good video production, Gold Disk also provides the ability to add titles. You'll need a video capture board with NTSC (TV-compatible) output or a VGA-to-NTSC converter to view the results on a television, however. We used Digital Vision's TelevEyes/Plus converter (reviewed in First Looks, September 27, 1994) with excellent results.

To prepare a title, simply type the words onto the screen and pick the most appropriate font, type size, color, and effects (such as drop shadows). You can animate the title in a variety of ways and preview it before putting it on tape. You can even record the title sequence into your camcorder as a scene or play it directly into the recording deck for professional-looking results. Beyond using titles to divide scenes, good titling is a handy way to include

PC, Camera, Action!



CONTROL: With Gold Disk's SmartCable, a PC can keep track of video clips and rerecord them onto a final video.

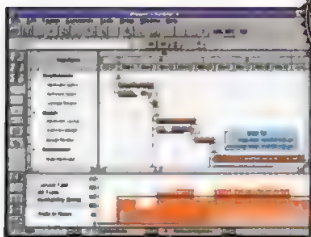


From November 28 through December 2, you can go on-line to discuss VideoDirector with Bill Machrone and Mike Lampietro, VideoDirector product manager. Type GO EXEC at any CompuServe! prompt.



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VideoDirector

CONTINUED FROM PAGE 54

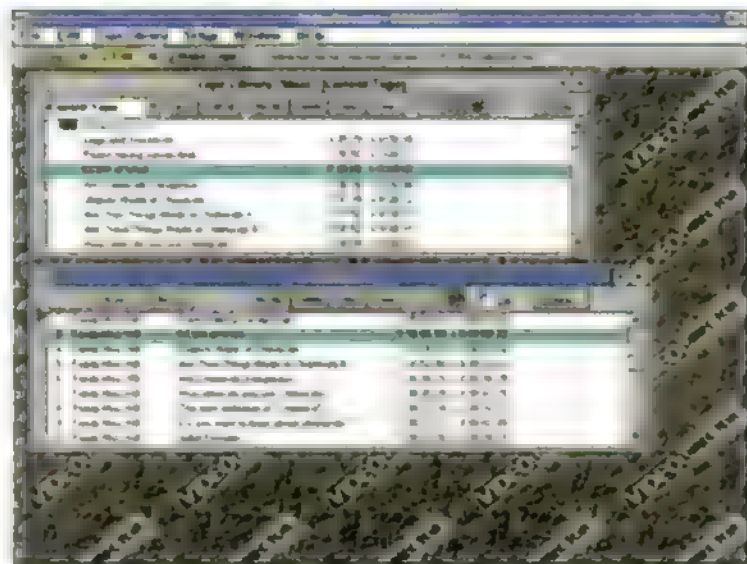
bullet points in video sales presentations.

In use, VideoDirector operates very smoothly. We took about two dozen clips from a variety of tapes and put together a 2-minute video, complete with titles, Excel charts, background music, and narration. The logging of scenes took longer than it should have because we were pointing and clicking on the start and stop buttons on the screen instead of using the shortcut keys, and we would occasionally miss the beginning or end of a clip and have to relog it. Once we got the hang of the interface, however, logging the video clips went quickly.

Once set up, the final video assembly was flawless. It was a

little eerie, however, watching the images roll by on the screen, hearing the camcorder and VCR whir, seeing the digital counters

them into a different order in the Event Window. Or you can start over with a totally different order. VideoDirector then rebuilds the new tape.



ARRANGE: With VideoDirector's Event List you can order the clips you want in the final videotape.

The big advantage that VideoDirector has over dedicated editing hardware: Once you've logged a tape, you can save the file and print out the log, producing an archive of the tape's contents. This archive log can help make your ragtag collection of home or

flash, and occasionally being prompted for a different source tape. Once the tape is finished, if you're not satisfied with the result, you can swap one scene with another by simply dragging

office videotapes nearly as accessible as a photo album. You can easily find any particular scene, and you can recreate or modify any assembled tape simply by calling up its Event List.

VideoDirector also performs its magic with professional and high-end consumer gear such as the Video Toaster and decks that use the VISCA control interface and time coding. Thus, the program has the ability to grow with you if you should decide that you want to upgrade your video equipment in the future.

If you're drowning in a sea of videotapes and need to edit them into some semblance of order, VideoDirector is an excellent way to put it all together in a professional-looking video.

► **VideoDirector 2.0 for Windows.** List price: \$199.95. Requires: 2MB RAM, 2.5MB hard disk space, Microsoft Windows 3.1 or later, Gold Disk Inc., Santa Clara, California; 800-982-9888, 408-982-0200; fax, 408-982-0298.

Circle 438 on reader service card

CD-ROMs

Want to Make Your Own CD? Kodak Can Arrange-It

BY DANIEL GROTTA AND SALLY WIENER GROTTA

Now that more PCs are coming equipped with CD-ROM drives and sound boards, the question becomes when we will be able to create our own CDs. Kodak's \$395 Arrange-It software is a powerful tool that can create sophisticated and interactive multimedia presentations from photographs, illustrations, text, voice recordings, music, and sound clips. About the only thing it can't deal with is video clips.

The script file that Arrange-It produces can be used to make Mac- and PC-compatible Photo CDs that can be displayed on a CD-ROM-equipped computer or any television set connected to a Photo CD player.

Arrange-It, however, is neither intuitive nor easy to learn, although the tutorial will help you get started. On start-up, the

program displays a toolbar and a menu bar, as well as two windows. The top one is called the Collection Window, and it depicts iconized graphics, text, and audio files. The Collection Window can accept almost any file format (.BMP, TIFF, and .WAV, among others). The bottom window is called the Document Window, where the presentation is diagrammed, assembled, and edited. This gives a bird's-eye view of the CD-ROM as it develops.

The first step in creating a CD script is marking and dragging an image, text, or audio file icon (called a node) into the Document Window. Depending on which tool is selected, the node is either a menu node (which uses a tabbed notebook metaphor for connecting to other nodes) or a sequence node (any image, text, or audio file that will display in a designated sequence).

If that sounds confusing, it is, particularly while you're trying to assemble several disparate elements. The documentation and help menus don't offer much assistance. But once you

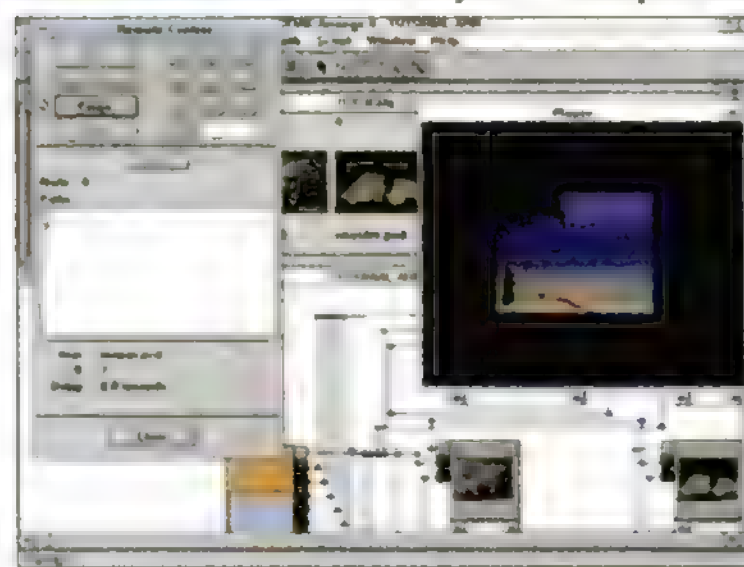
track of the pathways, you'll have complete control. Depending upon how complex the CD will be, the nodes and their connecting lines can look very complicated, similar to an inter-

state map. The script Arrange-It produces along with the graphics, text, and audio files must then be sent to one of the 500 service bureaus, photo labs, or quick-printers that are equipped with the hardware and software necessary to master the disk.

While it is still far from user-friendly, Arrange-It is the best way to make your own CD.

► **Arrange-It.** List price: \$395. Requires: 8MB RAM, 40MB hard disk space, Microsoft Windows 3.1 or later, Photo CD-compatible CD-ROM drive; sound board optional. Eastman Kodak Co., Rochester, New York; 800-235-6325.

Circle 427 on reader service card



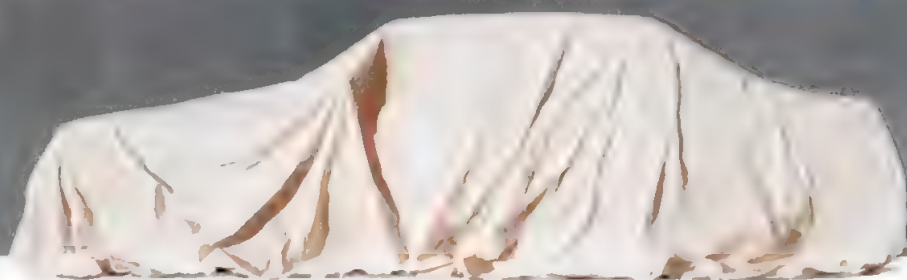
CONNECT-THE-DOTS: Arrange-It lets you create a CD-ROM by connecting the elements.

start working with menu and sequence nodes, the differences become second nature.

Designing an interactive presentation is done by using the mouse to draw a path from one node to another, and indicating what the sequences and branching options will be. Modifying node characteristics and permutations can be an exercise in convoluted logic, but if you keep

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ISA Plug-n-Play Compliant	X	X	X	
Multilevel Security Features	X	X	X	X
Asset tracking	X	X	X	
PC tattooing	X	X	X	
Optional Desktop Management Software	X	X		
Bi-directional parallel port	X	X	X	X
Desktop Management Interface (DMI) ²	X	X		



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- 8-MB RAM, expandable to 96-MB
- Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution

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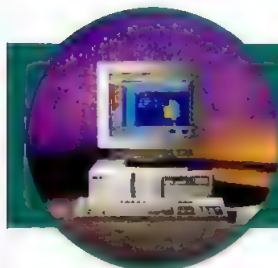
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- 270-MB, 12-ms Fast SCSI-2 hard drive¹



HP Vectra VL2

- Desktop Power Management
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- Optional 128- or 256-KB cache memory^{*}
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HP Vectra N2

- 1 MB of video RAM standard, expandable to 2 MB
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- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²



HP Vectra M2

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- Optional integrated 10Base-T networking
- Systems Diagnostics Utility
- EPA Energy Star certified
- ISA Autoconfiguration utility (Plug-n-Play)
- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²



HP Vectra XM2

- 8-MB RAM, expandable to 96-MB
- PCI Integrated 64-bit S3 Vision-864 graphics accelerator supporting up to 1280 x 1024 resolution
- Optional PCI Integrated 32-bit 10Base-T networking
- Integrated Desktop Management Interface (DMI)³
- EPA Energy Star certified
- Free three-year limited warranty for parts and labor²



HP Vectra XU

- Integrated 32-bit PCI SCSI-2 interface
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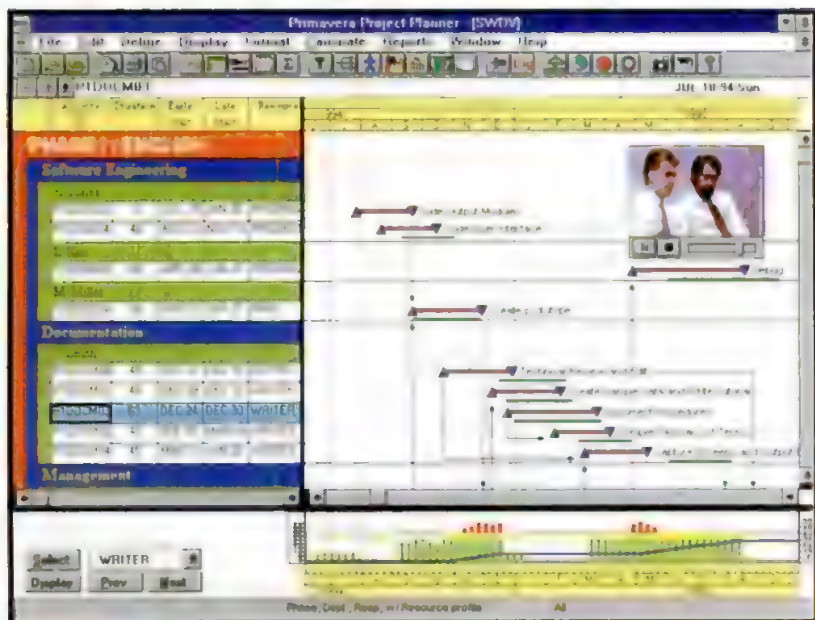
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All HP Vectra PCs come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed; HP mouse and keyboard included. *Feature included with some models. ¹U.S. list price, dealer prices may vary. Monitor not included. ²Other capacities available. ³First year on-site, 24-hour service. Second and third year return to dealer. ⁴Available 10/1/94. ⁵With permission CRN/Benchmark. MS-DOS is a U.S. registered trademark and Windows is a trademark of Microsoft Corporation. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. PPG407 © 1994 Hewlett-Packard Company

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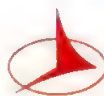
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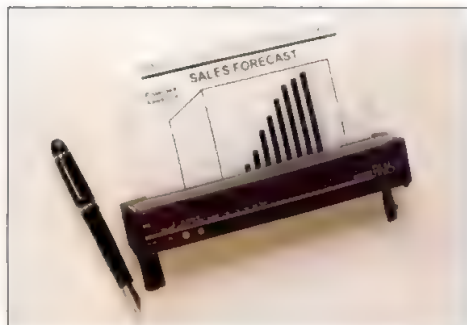
NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Jonathan Matzkin and Asa Somers

NEW

Citizen America Introduces the Lightweight PN60 Color Printer

Citizen America Corp. is now shipping the tiny PN60 color printer, which measures a mere 2 by 10 by 1.85 inches (HWD) and weighs only a pound (1.5 pounds with the optional rechargeable battery). The PN60 uses Citizen's thermal fusion technology to produce laser-quality color output at 360 dpi. The unit can output up to two color pages per minute and can print from 30 to 50 pages on a single battery charge, depending on coverage. You can print on plain paper, envelopes, and transparencies (the unit has no paper tray, however, so you must feed the sheets by hand), and the PN60 comes with five built-in fonts and supports



The PN60 prints laser-quality color and weighs only a pound.

TrueType and Adobe fonts. The unit also comes standard with an international power supply.

► **Citizen PN60.** List price: \$429. Citizen America Corp., Santa Monica, California; 800-477-4683, 310-453-0614; fax, 310-453-2814.

Circle 428 on reader service card

IMPROVED

The Major BBS 6.25 Reaches To the Internet

Ease of setup and complete configurability are the trademark characteristics of The Major BBS, a DOS-based bulletin board software package from **Galacticomm**. Version 6.25 adds access to the Internet with the new

HOT PROSPECT



The Tadpole P1000: A New High End for Portable Computing?

The executive who wants only the latest and greatest will have to test-drive a Tadpole P1000, the first 100-MHz Pentium-based notebook, from **Tadpole Technology**. It can be configured with up to 128MB of RAM and an 810MB removable hard disk for true desktop-replacement portable computing.

Tadpole has engineered a way to use the P1000's magnesium-alloy case as a heat sink to cool the P54C processor. The case gets slightly warmer as processing continues, but the temperature change is not drastic. The internal nickel hydride battery gives about 2 hours of continuous use; an optional external nickel cadmium battery provides up to 8 hours. The unit weighs 7.5 pounds with the internal battery installed.

The P1000 comes with a 10.4-inch active-matrix TFT color screen. It also features an external floppy disk drive, an integrated point stick, and a PCMCIA slot for one Type III or two Type II cards.

Tadpole's Advanced Notebook Architecture will let you upgrade to more advanced processors as they appear on the market, including faster Pentiums and Intel's much-touted P6 chip. The processor is part of a modular design, and it quickly snaps off the motherboard for do-it-yourself replacement.

► **Tadpole P1000.** List price: With 8MB DRAM and 340MB hard disk, \$7,495. Tadpole Technology Inc., Austin, Texas, 800-232-1881, 512-219-2200; fax, 512-219-2222.

Circle 406 on reader service card

Internet Connectivity Option, which gives Telnet, FTP, and World-Wide Web access. Version 6.25 also adds support for intelligent multiport boards from Equinox Systems, which boost performance over that of Galacticomm's own plug-in multiple-serial-port boards. With the Equinox hardware, you can host over 100 simultaneous users on a single dedicated Pentium-based PC. Users can connect via modem, LAN, and serial link.

► **The Major BBS, Version 6.25.** List price: \$258 (free upgrade from Version 6.2); Internet Connectivity Option, \$995. Galacticomm Inc., Fort Lauderdale, Florida; 800-328-1128, 305-583-5990; fax, 305-583-7846.

Circle 408 on reader service card

NEW

A Tablet with a Light Touch

AceCad's AceCat II 5- by 5-inch graphics tablet relegates bulky battery-powered pens



The AceCat II from AceCad.

to the past with its FeatherLight stylus, which receives power from the tablet's cord. Capable of a maximum resolution of 2,000 lines per inch with an accuracy of ± 0.01 inches, the AceCat II lists for \$129. The tablet

installs through a standard serial port or a PS/2 keyboard connector.

► **AceCat II.** List price: \$129. AceCad Inc., Monterey, California; 800-676-4223, 408-655-1900; fax, 408-655-1919.

Circle 426 on reader service card

NEW

HP LaserJet Delivers Color for All

Hewlett-Packard Co. hopes the Color LaserJet will do for color what the company's earlier products did for monochrome laser and ink jet printing. Listing for \$7,295, the new LaserJet does the work of a printer selling for thousands of dollars more, setting the stage for

New & Improved

the proliferation of color in business. The 300-dot-per-inch LaserJet uses an AMD 20-MHz RISC processor and caches frequently used colors to speed printing. Capable of printing two color pages per minute or one transparency per minute, the LaserJet's speed is competitive; at 10 ppm, the LaserJet's monochrome print speed rivals many black-and-white laser printers. Moreover, it can print on 11- by 17-inch sheets. Based on a new printing technology, the LaserJet produces images that won't smudge or smear. The unit comes standard with 8MB of RAM and PCL 5; Adobe PostScript costs an additional \$799.

► **HP Color LaserJet.** List price: \$7,295. Hewlett-Packard Co., Direct Marketing Organization, Santa Clara, California; 800-752-0900, 208-323-2551; fax, 800-333-1917.

Circle 407 on reader service card

NEW

DSP Modem Does V.34 and More

Digicom Systems has announced a new digital signal processor-based modem capable of V.34 communications at 28.8-Kbps throughput. With software upgrades, Digicom's Connection 288DF can operate at any of several standard data rates. Because the unit is based on a DSP, the 288DF can be upgraded through software to future standards, and even 28,800-bps fax transmission reception. Digicom posts software upgrades for the Connection 288DF

modem on America Online.

► **Connection 288DF.** List price: \$279. Digicom Systems Inc., Milpitas, California; 800-833-8900, 408-262-1277; fax, 408-262-1390.

Circle 409 on reader service card



With software upgrades, the 288DF will support future transfer rates.

IMPROVED

Instant Business Applications With Alpha Five

Alpha Software Corp.'s new database, Alpha Five for Windows, targets business users who need to move quickly from application concept to working program. It combines ease of use with powerful database-development tools in one package, and provides user-friendly enhancements such as drag-and-drop applications creation and intuitive data-input controls

BRIEFS

Software

New England Business Service (NEBS) has introduced a DTP package to help small businesses produce promotional materials such as brochures, business cards, newsletters, and letterhead. Page Magic (suggested list price, \$69.95) comes with more than 100 templates that eliminate the need for extensive layout and design work; the templates match paper products NEBS sells 603-880-5100; fax, 603-880-5102

Gupta Corp. has created an object-oriented, graphical interface to store procedures in Oracle relational databases. QuickObjects will be available in early 1995 as part of SQLWindows 5.0 and will allow developers to incorporate stored Oracle procedures in their SQLWindows applications without additional programming. QuickObjects builds an "object wrapper" around stored procedures, which shields you from much of the complexity of building these procedures into applications from scratch. You simply drag and drop objects or classes of objects into business applications as you develop them. 415-321-9500, fax, 415-321-5471.

Money Maker for Windows, Version 2.0 (\$59.95 through December 31; \$99 thereafter), from **Q-West Associates**, offers access to CompuServe for automatic downloading of current securities prices as well as price histories. You can also "quick call" Prodigy's Quote Track to update quotes for products held in your portfolio. A new charting component draws 2-D and 3-D graphs of historical data, portfolio performance, and financial reports. A cash account portfolio helps you manage cash flow among all of your security holdings. 619-484-6648, fax, 619-484-8606

A new wireless news-delivery system for Lotus Notes accesses Dow Jones, Reuters, the Associated Press, and 150 other information providers. News is automatically formatted for Notes and written to Notes databases. **Mainstream Data's** system costs \$995—plus \$995 for the FM data receiver—with hardware installation included. Subscribers can receive FM

called Field Rules. It also includes a full-featured programming language, Xbasic, for developers. The package represents Alpha Software's first foray into the Windows environment and an upgrade to the company's popular Alpha Four DOS database. The new Windows package also includes form-letter word processing capabilities and drag-and-drop reports design.

► **Alpha Five for Windows.** List price: \$495 (introductory price, \$149); introductory upgrade from Alpha Four, \$69.95. Alpha Software Corp., Burlington, Massachusetts; 800-451-1018, 617-229-2924; fax, 617-272-4876.

Circle 410 on reader service card

NEW

Turtle Beach Rolls Out the Tropez

Turtle Beach has for years marketed some of the best high-fidelity approaches to PC sound. Now, the company has brought its high-quality sound to the value-conscious multimedia and game markets with the multipurpose Tropez audio board. The Tropez features wavetable audio with 128 MIDI instruments, and its SampleStore lets you save .WAV files as MIDI voices. The board comes with a sound editor, an OLE-compatible recorder, and music-composition software. The Tropez's \$249 list price places it firmly in the one-size-fits-all range.

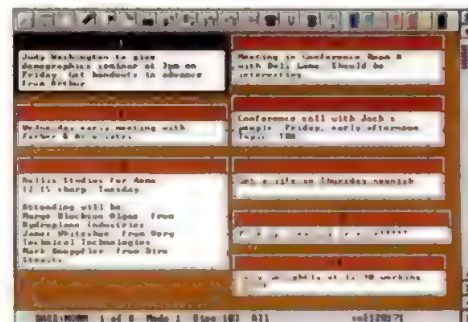
► **Tropez.** List price: \$249. Turtle Beach Systems, York, Pennsylvania; 800-645-5640, 717-767-0200; fax, 717-767-6033.

Circle 411 on reader service card

NEW

Micro Logic's PIM Slims Down

Micro Logic Corp. has reduced the scope of its Info Select personal information manager, creating a bare-bones program that will appeal to users who are tired of PC software clutter. You'll like Info Select Express (ISE) if



Post electronic messages to yourself with Info Select Express.



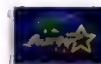
17" Series

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You know you can expect bright, brilliant colors and razor-sharp images from every Hyundai monitor. And now you can expect a wealth of savings every time you use one of our 14-, 15- and 17-inch monitors. By incorporating the latest in technology, our monitors save more energy, time and money.

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Save Money — With their exceptional value and outstanding quality, every Hyundai monitor can save you money. And there's little chance you'll waste money on repairs with Hyundai's 24-month warranty, 48-hour express repair service, and reputation for commitment to quality. That means a more attractive value for you.



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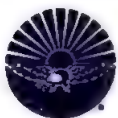


It's good
for your output.



It's good
for your world.

Your return supports



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Conservancy

The Canon cartridge. In laser beam printers, personal copiers and plain paper fax machines, it's the heart of the desktop publishing revolution that's transformed homes and offices around the globe.

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Replacing the cartridge not only ensures the highest output quality.

Please recycle your Canon cartridge.

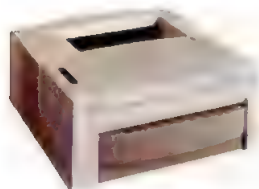
It makes your equipment
good as new, and that

means virtually maintenance free. It's clean as well as simple, too; so there's no need to dirty your hands.

For output quality and operating convenience, no other system comes close. And here's the point we'd like to emphasize — when the cartridge is properly recycled, no system is more environmentally friendly.

When returned to Canon, cartridges are carefully disassembled. Reusable parts are painstakingly screened and cleaned. Over 95 % by weight of collected cartridges' parts and materials are used in making new cartridges or other products. The result: It's good for you. It's also good for the earth. Recycle your Canon cartridge. Please.

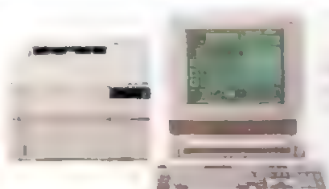
As part of our Clean Earth Campaign in the United States, for each cartridge returned, Canon contributes one dollar that's divided equally between the National Wildlife Federation and The Nature Conservancy. Shipping costs for the used cartridge are paid by Canon, so there's no charge to our customers. Easy shipping instructions can be found in the cartridge box.



Laser Beam Printer LBP-430



Personal copier PC320



Electronic Filing System Canofile 510



Fax Laser Class 5000

Canon

New & Improved

you don't need all the functions of a full-blown PIM or don't have the space on your notebook hard disk to accommodate one. ISE dispenses with a complex organizational structure and concentrates instead on ease of input and searching. If your method of staying organized is to post paper reminders, then ISE's "electronic scrap paper" will feel natural. The package includes on-line documentation instead of a printed manual.

► **Info Select Express.** List price: \$29.95. Micro Logic Corp., Hackensack, New Jersey; 800-342-5930, 201-342-6518; fax, 201-342-0370.

Circle 412 on reader service card

IMPROVED

Fuzzy Logic Helps Searches

DT Software has bolstered dtSearch, Version 3.0, in both DOS and Windows versions by including support for phonetic spelling and fuzzy logic-based searches. Indexing and searching are faster than in previous versions; part of the DOS version's speed boost comes from the inclusion of a Phar Lap DOS extender. A server-based version is compatible with all major PC-based networks, according to the company.

► **dtSearch, Version 3.0.** List price: single user, \$149; 5 users, \$650. DT Software Inc., Arlington, Virginia; 703-521-9427; fax, 703-521-6140.

Circle 413 on reader service card

NEW

Compaq Contura 400 Targets Midrange with New Features

Compaq's value-oriented Contura 400 series of notebook PCs provide increased power and functionality compared with the older Contura line, but have limited display and hard disk choices. The 400C model comes with a 9.5-inch dual-scan passive-matrix color screen, and the 400CX has an 8.4-inch active-matrix color screen. Both the 400C and 400CX come standard with 4MB of RAM (upgradable to 20MB) and 250MB hard disks and can accommodate either two Type II PCMCIA cards or one Type III PCMCIA card. An innovative



The Contura 400CX.

BRIEFS

Software

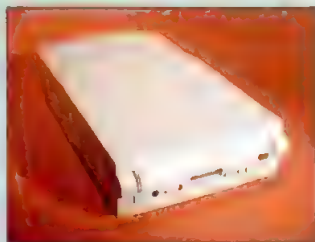
subcarrier feeds in 14 major US metro areas. If you're not in one of these areas, you'll need Mainstream's small satellite dish (\$1,490) to get the feeds. Monthly subscriptions to the news-wires begin at approximately \$30. 801-584-2878.

Now Lotus Notes users can get into the World-Wide Web without ever having to leave the Notes workspace. **Wolf Communications'** WorldComm Web gateway lets Notes users retrieve text and files from any Web site—world-wide—in Notes format. WorldCom is an international network for Notes users. Aside from Web access, WorldCom provides an Internet gateway to e-mail, Usenet newsgroups, mailing lists, and FTP sites. Standard U.S. rates based on connect time are \$28.50 per hour over toll-free lines. 800-774-2220.

Thuridian Software Engineering has introduced a Lotus Notes add-on (\$99) to its LabelPro for Windows. The Notes version provides direct access to Notes databases and includes label templates for shipping, addresses, file folders, and rotary cards. You can add graphical elements to labels created from within Notes, and the product automatically fits text to labels, so you don't have to bother with font size adjustments. 408-439-9800, 800-579-1806.

Hardware

NEC's new MultiSpin 4X series of quad-speed CD-ROM drives start at \$415. The drives come with music play-



back controls, double dust doors, and automatic lens cleaning, as well as front-mounted LCD panels. The \$515 MultiSpin 4Xe (shown above) features a 600-Kbps transfer rate and an average access time of 22 ms. 708-860-9500.

feature is the full-size keyboard that tilts 4 degrees for greater comfort. Each unit measures 2 by 11.9 by 8.9 inches (HWD) and weighs just under 6 pounds. Each Contura 400 unit features a small LCD status panel above the keyboard that shows the remaining battery life and which components are being used. The nickel hydride battery produces a respectable 3.5 to 5.5 hours of continuous use, according to Compaq. Each model also offers one user-definable and three preset levels of power management and comes with DOS 6.2, Microsoft Windows 3.1, Lotus Organizer, TabWorks, and on-line documentation and tutorials.

► **Compaq Contura 400C and 400CX.** List price: \$2,599 to \$3,299. Compaq Computer Corp., Houston, Texas; 800-345-1518; 713-378-8820; fax, 713-378-1442.

Circle 414 on reader service card

NEW

Single Add-In Card Offers Multiple I/O Capabilities

Short on slots? You can take care of a variety of input/output needs in a single slot with the F/PortIDE from **FarPoint Communications**. The card provides a controller for two IDE hard disks and a controller for two floppy disk drives, as well as a game port, two 16550 UART-compatible serial ports, and an IEEE 1284-compliant parallel port. The parallel port supports the Enhanced Parallel Port and Extended Capabilities Port protocols, which will be implemented in Windows 95. FarPoint says the F/PortIDE offers throughput 10 to 50 times as fast as that provided by ordinary parallel ports with any standard Centronics interface laser printer.

► **F/PortIDE.** List price: \$129. FarPoint Communications Inc., Lancaster, California; 805-726-4420; fax, 805-726-4438.

Circle 420 on reader service card

NEW

Compact Flat-Bed Scanner Provides Low-Cost Gray Scale

The IX-3010 gray-scale scanner from **Canon Computer Systems** ships with Caere's OmniScan Plus and a sheet feeder, which adapts the unit to OCR, image-editing, and copying uses. The compact scanner (3 1/8 by 11 1/8 by 15 11/16 inches) provides true 300- by 1,200-dpi resolution and comes with a Twain 2.0 driver. You also get Caere's PageKeeper

How to

It's not easy, this
Internet thing

The only way to make the most of the archaic software packages that give you limited access to the Net, and unlimited opportunity to get lost, lost, and waste hours downloading one document at a time.

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make the Internet Work

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LITE

1-800-453-SURF for your free copy of InternetWorks LITE. Or, current Internet users can download it on-line: [ftp://ftp.booklink.com/lite](http://ftp.booklink.com/lite).

New & Improved

Portfolio software, which helps you manage paper and electronic files. The IX-3010's xenon lamp eliminates the flicker and changes in brightness that can occur with fluorescent scanner lamps, according to Canon. A two-year warranty offers next-day replacement of defective scanners.

► **Canon IX-3010.** List price: \$569. Canon Computer Systems Inc., Costa Mesa, California; 714-438-3000; fax, 714-438-3099.

Circle 421 on reader service card

NEW

CIA Gets the Goods on the Competition

To succeed in business, you need as much information about your competitors as you can lay your hands on. **Competitive Intelligence Agent (CIA)**, from CIA Software, is a database of information sources on companies, industries, markets, and technologies. You simply select a keyword and the program produces a list of potential sources; CIA will even dial a company's phone number for you. The program contains a librarian that includes descriptions of hundreds of strategic databases worldwide. Its assistant suggests research and analysis techniques.

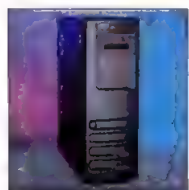
► **Competitive Intelligent Agent.** List price: \$99. CIA Software, Alameda, California; 510-521-4375.

Circle 422 on reader service card

IMPROVED

AST Research Makes Manhattan a Bigger Place

AST Research has redesigned its Manhattan server to accommodate a pair of 100-MHz Pentium processors for better performance and data throughput. The PCI/EISA Manhattan P5100 server features AST's FastFlex architecture, which allows simultaneous access of external cache and system memory. Capable of holding 256MB of error-correcting



AST's Manhattan now holds two 100-MHz Pentium chips.

memory, the Manhattan P5100 has an optional dual-channel SCSI RAID drive array. It can be ordered in a black tower case or as a rack-mounted computer for those who value floor space. With the Manhattan, AST will be pre-

BRIEFS

Hardware

Solid-state "disks" can boldly go where mechanical disk drives fear to tread. **SunDisk** has just unveiled its SDIA-80, an 80MB 1.8-inch flash-storage device that doubles to 160MB when you use the included Stacker software. The IDE storage device is designed to be plug-compatible in systems that would otherwise use mechanical 1.8- and 2.5-inch hard disks. It's intended for OEM uses in industrial applications where harsh operating conditions cause problems for rotating media. Volume OEM pricing is below \$2,000 per unit. 408-562-0500; fax, 408-562-0503

Portable computer users who need a level of security not provided by password-only protection can look to the Toven Secure Notebook from **Toven Technologies**. The unit requires the use of a smart card and a password to gain access to the system. A smart card is a credit card-size device that includes a microprocessor, which serves as an electronic key. The Secure Notebook comes in a variety of configurations and starts at \$2,300. 416-369-9790.

Sealevel Systems' AV-COM (\$249) is an interface card that controls a variety of devices in high-end audio/video automation and control systems. The two-channel board offers two serial ports (with 16550 UARTs) that support audio and video connection standards used by studio professionals. The serial ports can be configured with jumpers as MIDI, SMPTE 207M, RS-232, and PA-422 connectors. An included DOS driver allows PCs to support up to 32 ports under DOS. Optional drivers allow for more than four serial ports under Windows 3.1 and OS/2. 803-843-4343; fax, 803-843-3067.

And Finally...

RasterOps is bundling a 64-bit SVGA graphics accelerator with its ClearVue-Color 17-inch monitor for under \$1,000.

... **Compaq** has announced a partnership with the Books That Work software publishing company and will bundle the "Home Survival Toolkit" with its Presario line of desktop PCs for the home. ...

Corex Technologies' CardScan 1.1 lets you scan business cards directly into many popular PIM programs.

miering Percepta network-management software that can diagnose server malfunctions and monitor vital hardware.

► **Manhattan P5100.** Estimated list price: *Base model*, \$5,300. AST Research Inc., Irvine, California; 800-876-4278, 714-727-4141; fax, 800-926-1278.

Circle 423 on reader service card

IMPROVED

Virus Detector Gets Speed Boost, Windows Interface

A new Windows interface shields you from the command line of **McAfee's** VirusScan, Version 2.1. Power users will also find 15 new or improved options for use from the command line. The scanning engine has been completely overhauled and delivers a four- to five-fold speed improvement, according to McAfee. VirusScan now separates files used to identify viruses from the scanning engine to allow for simpler, more frequent updates of virus signatures. New filters reduce the amount of data needed to identify a virus. The program now identifies more than 2,600 viruses.

► **VirusScan, Version 2.1.** List price: \$129.99. Site licensing available for as few as five users. McAfee Inc., Santa Clara, California; 408-988-3832; fax, 408-970-9727.

Circle 424 on reader service card

NEW

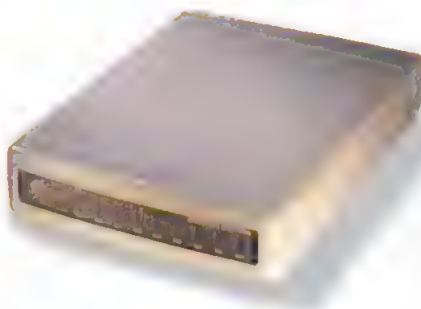
SCSI Adapter Works Double Time

AdvanSys has engineered a dual-channel SCSI host adapter that does single-channel boards one better. The AdvanSys ABP852 adapter installs in a single bus-master slot, and handles up to seven devices in each of its two 10-megabit-per-second SCSI channels for a total load of 14 devices. AdvanSys says the adapter can give SCSI devices up to four times the data throughput compared with ordinary SCSI boards. AdvanSys sells the ABP852 in two different kits. The AdvanSCSI VL Dual Bus Master Silver Kit for individual PCs and file servers includes Corel SCSI Version 2 drivers. The Gold Kit, for Novell RAID-based file servers, adds Corel's Network Manager, RAID software (supports levels 4 and 5), and jukebox software.

► **AdvanSys ABP852.** List price: *AdvanSCSI VL Dual Bus Master Silver Kit*, \$479; *Gold kit*, \$699. AdvanSys, San Jose, California; 800-525-7443, 408-383-9400; fax, 408-383-9612.

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How to get eight people in the same conference room at the same time.

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If you've ever tried to arrange a meeting, you know the degree of difficulty is somewhere between nailing a triple gainer with a half twist and eliminating the national debt. It's not for amateurs or the faint of heart. But all that's about to change. Introducing GroupWise 4.1, a new member in the family of Novell GroupWare. GroupWise capitalizes on the advancements of its predecessor—WordPerfect® Office 4.0—and offers features not found in any of its competitors. For instance, with the Busy Search feature of the integrated e-mail calendar/schedule program, you can quickly determine the best time for 8 (or 80) people to convene. Regardless of their locations or operating systems. More than message-based scheduling, GroupWise integrates task management, so you can delegate an assignment, track its acceptance and manage its completion before the first attendee arrives. With GroupWise, we've made it incredibly easy to set up a meeting. Of course, you still have the daunting task of keeping people awake in one. Call 1-800-370-8987 for your nearest certified reseller or to learn more about Novell GroupWare, the perfect way to put people together with information.



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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by *Tin Albano*

Entertain and Educate Your Kids Painlessly

BY J. W. OLSEN

Multimedia edutainment is downright infectious, and even computer-literate parents report rampant, feverish fear when configuring a multimedia system. William P. Mann's *Edutainment Comes ALIVE!* provides a powerful antidote for the mania while calming parents' fears.

From the instant you set eyes on this book and CD-ROM, you know it's designed for the home. With calendered stock throughout, an oversize (and oddly sized) format, countless quality illustrations, and inviting typography, it belongs on your coffee table rather than in the reference library. The book encourages you to browse through it over a cup of coffee, then later read sections that interest you. Have your kids pick favorite screen shots; then learn about the products, where to obtain them, and how to run them.

Mann eases you into this brave new world by discussing edutainment ("software that integrates education and entertainment"), describing a basic multimedia system, and dividing edutainment into seven categories to facilitate discussion. The next hundred pages cover these categories in relaxed but informative detail, from preschool products through student aids and multimedia references to games and general edutainment.

When you're ready for the details of multimedia, Mann outlines just what you need to know to purchase or upgrade a proper multimedia environment. If someone in your family has spe-

cial visual, hearing, or mobility needs, you'll welcome a chapter covering available adaptive technology. Everyone will appreciate chapters on troubleshooting DOS, Microsoft Windows, and the uglies of CD-ROM and sound peripherals.

What about the future? The author covers the new trends in

multimedia hardware and software so you will be prepared, and interviews some of the leaders in the field today. Appendices describe CD-ROM technologies, discuss the field of telecommunications (for those who want to explore the plethora of on-line edutainment products), list MPC specifications, and provide a substantial glossary.

Of all the prescriptions available for your family's multimedia edutainment addiction,

Edutainment Comes ALIVE! offers the best combination of information and enjoyment.

► **Edutainment Comes**

ALIVE! by William P. Mann, \$39.99. Sams Publishing, 800-428-5331. ISBN: 0-672-30450-3.

Circle 522 on reader service card



It's Still Not Dead

BY JAY MUNRO

DOS is definitely not dead. If you like tinkering at a system level, the latest entry in the Andrew Schulman Programming series, *DOS Internals* by Geoff Chappell, sheds light into the dark holes that DOS programmers have run into over the years. The book focuses on both the documented and undocumented aspects of practical DOS programming.

Chappell starts with a disclaimer: The book is an analysis of DOS, Versions 5.0 and 6.0, with some historical references back to DOS, Version 3.1. He is occasionally difficult to read, and has

a rather matter-of-fact way of discussing his subject. Throughout the book, however, Chappell provides practical examples in Assembler and C that programmers can experiment with, as well as several useful utilities. Source and executables are contained on the included floppy disk, as well as header files that contain symbols, macros, and structures that programmers can use.

DOS Internals starts by laying out a groundwork knowledge of system configuration: explaining IO.SYS, the relationship DOS has with the BIOS, and the MSDOS.SYS DOS kernel. Digging deep into how the system

loads, segment structure, and disk and memory considerations, Chappell provides many diagrams and lists to help the reader understand how DOS puts all this together. Memory allocation is then discussed, with a practical C example that lets the programmer test a section of memory. XMS and extended memory are extensively covered, including accessing extended memory from real mode. To give an example of the book's depth of coverage, the A20 line has its own chapter, and there is also a good chapter on HIMEM.SYS.

The book covers TSR (terminate and stay resident) and device driver programming for C programmers, with examples that dispel the rumor that only Assembler can be used at that level. The DOS disk system is covered as deeply as other topics, explaining low-level disk support, DOS partitioning, and bootstrapping.

If you program in C or Assembler or just like to know how things work, this book will be a valuable addition to your library.

► **DOS Internals**, by Geoff Chappell, \$39.95. Addison-Wesley, 617-944-3700. ISBN: 0-201-60835-9.

Circle 521 on reader service card



Read Only Recommends

Boggled by the vastness of the information superhighway? Unsure where to find that one special bit of cyberinfo? Just let your fingers do the walking through *The New Rider's Official Internet Yellow Pages* by Christine Maxwell and Czeslaw Jan Grycz. \$29.95.

New Riders Publishing, 800-428-5331; ISBN: 1-56205-306-X.



The New Compaq Contura 400CX



1-800-345-1518

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COMPAQ



386-based PCs



486-based PCs

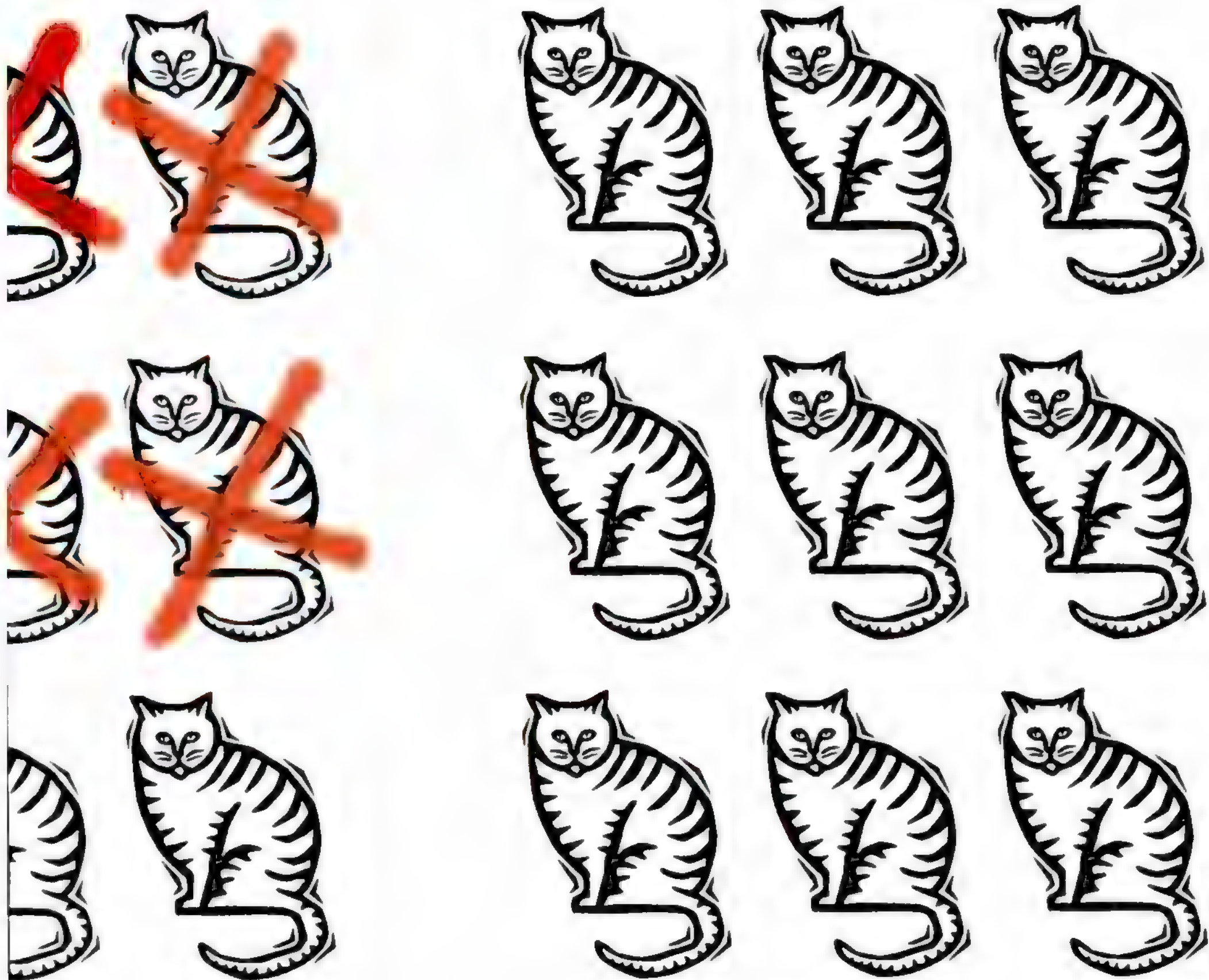


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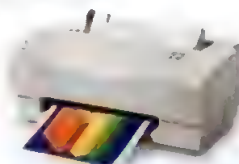
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through image processing at RISC-speed—the fastest in its class. The Phaser 140 supports PCs, Macs, and networks simultaneously. And it's from Tektronix, a Fortune 500 leader, where value in workgroup color printers now starts at only \$1,695, and doesn't stop until you finish first.



Tektronix

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Michael J. Miller

Another Microsoft Magic Show?

Remember the old shell game? It uses a technique called misdirection. You watch a magician move shells around and you frantically try to follow the one with the pea, but what you don't know is that the magician has already palmed it.

Some software developers think Microsoft played magician a few years ago, publicly extolling OS/2 as the operating system of the future while it quietly prepared Windows 3.0 and Windows applications. We all know which one became the dominant operating system.

Could there be another PC shell game in the works? We've started hearing suspicions that Microsoft is once again donning a top hat and white gloves, but this time, while we're all concentrating on the Windows 95 razzle-dazzle, the palmed pea will be Windows NT.

Windows NT? Wasn't that last year's news? Well, yes—but remember, the hand is quicker than the eye. Microsoft's latest release of NT—Version 3.5 (code-named "Daytona")—just shipped. This time around, however, the product will be available in two versions, the Server Edition and the Workstation Edition.

PLACE YOUR BETS

For the purposes of this argument, let's look just at the Workstation Edition. NT remains a true multitasking, multithreaded operating system; its only real competition comes from OS/2. While NT was designed for new 32-bit applications—written to what Microsoft calls the Win32 API—it's compatible with the bulk of Windows 3.1 applications (though not the 16-bit device drivers of DOS TSRs). The new version of NT isn't only simpler to get up and running, it also requires less memory than its previous incarnation—though you still want 12MB to 16MB.

Let's look at the facts:

- **Windows 95, the much-discussed "Chicago" replacement of Windows 3.x,** is also a multitasking, multi-threaded OS that's designed for Win32 applications and can still run the existing Windows 3.1 applications.

In other words, its broad definition is about the same as NT's. But NT has a server component, offers a higher level of security, and is portable to other non-Intel-compatible systems.

- **Almost all developers want Microsoft to license them** the new Windows logo signifying that their new applications work on Windows 95. In order to get this license, Microsoft insists, the applications written for Windows 95 have to run on NT as well. Some developers object to the prohibitive fee Microsoft is asking.

- **NT is here and it works.** Windows 95 seems at least six months behind it.

- **NT has the familiar user interface** made popular by Windows 3.1. Microsoft can certainly argue that the new interface in Windows 95 is more sophisticated, more intuitive, and better designed for new users, but the fact remains that millions of PC users already know the Windows 3.1 interface. Also, many corporations have already said they fear the retraining costs normally associated with a new interface. NT gives them the applications and the features with none of the complications.

- **NT will be available for PowerPC-, Alpha-, and MIPS-based platforms,** as well as Intel-based systems, giving Microsoft an edge if IBM or anyone else decides to go to the PowerPC. If that were to happen, and the portable NT were to become the dominant OS on these other platforms, it would break the hegemony over the PC industry, freeing Microsoft from Intel. Microsoft would become even more dominant, and its influence on other platforms would increase.



Watch carefully. Rumor has it that Windows NT may be the next mainstream operating system.

Michael J. Miller

CHICAGO FOOP?

So is "Chicago" just a smoke screen? It seems that Microsoft is putting a lot of effort behind Windows 95. The new user interface probably will make things a lot easier, such as launching applications and switching between them, making network connections, and managing your files. Windows 95 also has a number of other features, including better communications and better connections with the Internet. Below the surface, Windows 95 offers a lot to software developers, but nearly all of these features are also found in Windows NT. Of course, Windows 95 is going to be less expensive than Windows NT, and as soon as it comes out it's likely to be bundled on most new machines.

Windows 95, however, is still months away. In the meantime, although they'd never admit it, the folks at Microsoft have to be at least a little worried by IBM's impressive new OS/2, Version 3, known as "Warp." OS/2 has long been a true multitasking, multithreaded operating system,

and its WorkPlace Shell user interface has been given some new changes that make launching applications easier. On the whole, the Workplace Shell looks far more up-to-date than the Windows 3.1 user interface. OS/2 has a number of new tools, such as easy connections to the Internet. It's also extremely compatible with Windows 3.1 applications, and it now can run on machines with smaller amounts of RAM, though you'll still want 8MB. In short, it's an impressive competitor.

ABRACADABRA, ALACAZAM!

Now here's the sleight of hand. Microsoft positions Windows 95 as the product for everyone, gets all the software developers to write for it, and so far seems to have done this flawlessly; virtually all the major software developers are talking about the Windows 95 versions of their products. But remember, Microsoft insists that these new Windows 95 applications also run on NT. When corporate customers start to complain about the training costs of changing user interfaces, Microsoft offers them NT, with its familiar interface. Microsoft also notes that the new 32-bit applications, created for Windows 95, won't run on OS/2. And Microsoft reminds

us that all these new applications will work on NT, regardless of the underlying processor a particular system may be using.

NT is more expensive than other operating systems, but Microsoft can set the pricing wherever it wants, depending on demand. And if the Windows 95 user interface becomes popular, Microsoft could always put it on NT sometime in the future, well before the big "Cairo" release.

Has Microsoft kept NT up its sleeve? Hardly. Microsoft has been quite open about telling the world that NT exists and what its features are. But Microsoft's public concentration—as well as the attention of most observers—has been on Windows 95. With magazine cover after magazine cover shouting out "Windows 95," it's hard to focus on anything else. But all the while, Microsoft has steadily improved NT and ensured that there will be a significant base of applications available for it.

Is Windows 95 merely a distraction? Is Windows NT is where the action is? Or are there just a lot of paranoid people in the industry who simply mistrust Microsoft and are imagining all this? One thing's for sure: Whatever the outcome, Microsoft has covered all its bets. □

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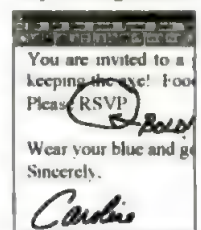
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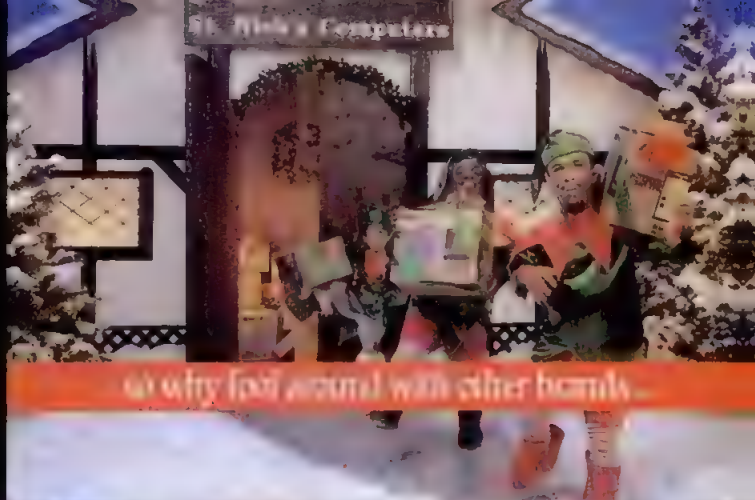
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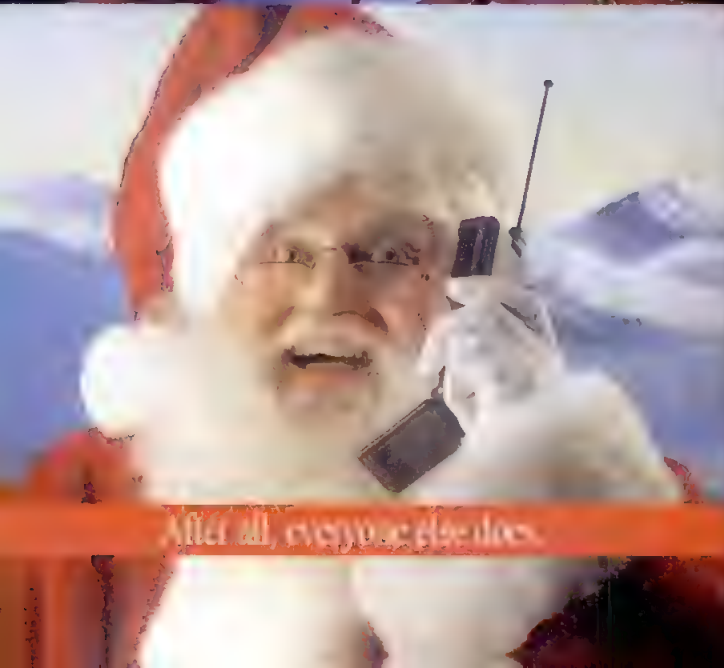
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Bill Machrone

Computers and Creativity

The PC is a 66-MHz millstone, grinding out the same old mundane tasks, ever faster. Instead of being the brain amplifier we've all dreamed of, it offers only the most prosaic help—checking our spelling, calculating accurately, conveying messages

to our coworkers. Sure, computers are used in the graphic arts, but what about *real* creativity?

And does real creativity have a place in the workaday business world? Anyone who's read a typical budget justification knows just how creative it can be. Granted, it's not as creative as a novel or a poem, but good business writing still demands the most persuasive and illuminating words to marshal support for your case.

Earlier this year, I wrote a column entitled "Thinking: You're Doing It Wrong" (*PC Magazine*, July 1994), which addressed the effect that our tools have on the way we handle ideas. I discussed a software tool, HyperForm, that encouraged and enabled structured thinking and thought processing. That column provoked a lot of e-mail conversations and a deluge of inquiries about the program's publishers, NDMA, of Ridgefield, Connecticut (203-431-0029).

THOUGHT TOOLS FOR THE PC

While HyperForm remains uniquely powerful, I've since adopted a more visual tool to foster creativity. Inspiration, from Inspiration Software, comes to Windows after years of success for the Macintosh. Inspiration lets you build ideas rapidly in outline mode or in flowchart-style diagrams. (See an evaluation of Inspiration in *First Looks*, September 13, 1994.) You start with a box that contains your central idea, and subsidiary ideas branch off from it, creating a branched overview of your developed concept. You can rearrange your thoughts through the conventional outline techniques of promotion and demotion, or you can drag boxes around until you're happy with the logic and flow. If you discover a new central idea along the way,

no problem. A keystroke makes it the new center of your document's universe.

Diagramming and brainstorming with Inspiration has increased my writing productivity. Once I've got a diagram with all the points I want to make, tied together logically in the right sequence, the actual writing moves closer to filling in the blanks and adding transitions. Introducing a new thought between two ideas that flowed nicely used to be very time-consuming; now I do much less of it, because I've got the project's flow mapped out in advance.

Just as NDMA recommends a course in structured thinking before you can use HyperForm to the fullest, Inspiration's documentation mentions a number of books that would augment the product. I've read a number of them, and they do help. The first, *Writing the Natural Way*, by Gabriele Lusser Rico, focuses almost solely on creative writing for self-expression. It encourages you to engage the right side of your brain by "clustering"—drawing word pictures of your central idea, all the associations you have for it, and the associations you have for those words.

The technique is surprisingly effective and is conceptually the same as the diagrams and idea maps that Inspiration produces. Back in 1983 when the book was written, the author had no inkling that a personal computer would one day enable you to draw those clusters and then revise and update them nearly at the speed of thought, without a lot of laborious scribbling, scratching, and erasing. If this book can't make you a better writer, nothing can.

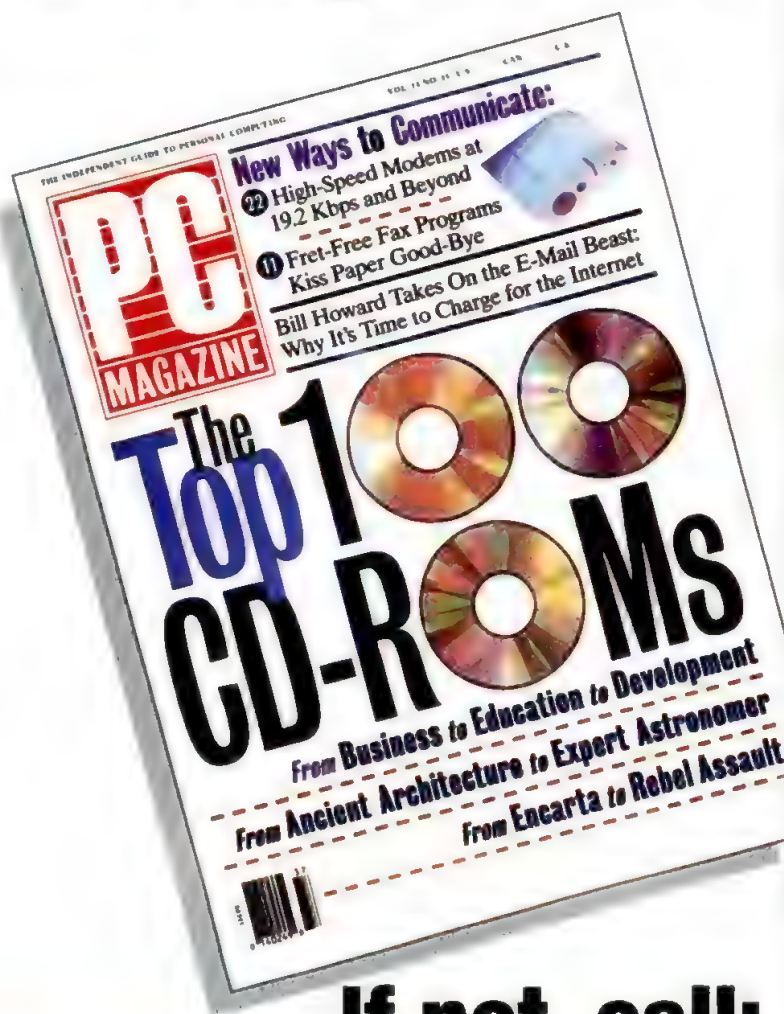
Another book, *Use Both Sides of Your Brain*, by Tony Buzan, is markedly different. He too endeavors to engage the right side of your brain by



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Bill Machrone

drawing what he calls *mind maps*. They look somewhat similar to Rico's clusters, but Buzan's approach emphasizes learning over creative expression. The real purpose of a mind map is to give you a taxonomy of a subject that focuses and organizes your understanding of it. Mind maps are also useful analytical tools that can help you plot a story or tie rote facts to more memorable visual images. Inspiration can create mind maps, too, although not with the same ease as clusters. Once you've built a mind map, however, you have the same ease of editing it by clicking and dragging, or turning the whole thing into an outline or raw text for further work.

NONE YOUR IDEAS

As interesting as both of these books are, they have more to do with the thought process than with business writing. *Thinking on Paper*, by V. A. Howard and J. H. Barton, is crammed with straightforward techniques for shaping your thoughts, getting them into draft form, and expressing them logically. The book's central thesis is that most of our thoughts are essentially half-baked until we put them into writing.

The process of expression, the authors say, is the logical continuation and completion of thought. Unlike the other books, *Thinking on Paper* doesn't have a single illustration, but it communicates its ideas simply and powerfully. The authors don't recommend a cluster or map, but they encourage you to jot down every fleeting impression and angle as you think about your topic, then make sense of it all later. Inspiration, once again, makes that process a snap. You blow a bunch of ideas onto the screen. Having each idea in its own little box clarifies your thoughts and encourages you to seek further thoughts and refinements.

In practice, that don't-care-where-it-goes scenario seldom happens. We approach our ideas—even the half-formed ones—with a structure and a concern for our readers. My diagrams tend to be fairly hierarchical, even from the outset. I might add more branches or move things around, but my purpose becomes clearer as I go.

I leave you with these words of encouragement: Everyone's a natural writer. There's no such thing as writer's block. You can harness the many dormant resources of your mind. Cool software makes it fun. □

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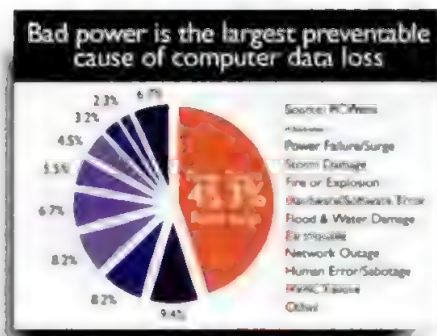
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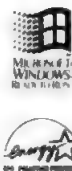
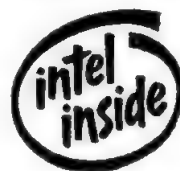
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John C. Dvorak

Mouse Shoulder: A New Ailment

I have a case of mouse shoulder. At first, I thought my aching shoulder was the result of sleeping on my arm and cutting off the circulation. Then I thought it was from a new tennis serve I was using that put a lot of spin on the ball. Then, one day while reach-

ing for the mouse, I realized the cause of my pain. Owwww! Mouse shoulder.

Here's how it happened.

For me, mouse shoulder was the result of a combination of Windows and America Online. Both of which require lots of mouse activity, unless you possess secret knowledge of shortcut keys. I usually write with the keyboard comfortably resting on my lap and my legs on the desk because it minimizes hand fatigue. My arms comfortably drape over the arms of my chair, allowing my hands to drop to the keyboard lying on my thighs. Needless to say, this is less than the perfect position from which to grab—much less use—a mouse. I think it's time to hook up my new IBM TrackPoint keyboard.

Instead of putting the keyboard on the desk and hunching over it the way everyone else does to access the mouse, I tried something new. I kept the keyboard on my lap, dropped my feet to the floor, and swung the chair around to the desk, allowing my right arm to swing out to grab the mouse. Try to imagine this: I'm sitting kind of sideways to the desk, the keyboard is in my lap, my right arm is outstretched, and my hand is on the mouse. Suspending my arm in this way, which is not dissimilar to something a Marine drill sergeant would have a recruit do for punishment, is the cause of my bursitis-like ache.

I'm still in agony. I believe that in addition to the outstretched-arm torture, the frequent need to move the mouse in a tight, precise pattern aggravates the situation.

This experience, as well as what I've read elsewhere about similar ailments, has led me to believe that we need a more serious study of ergonomics—the relationship between human and machine—to prevent minor irritation or serious disabil-

ity. Carpal-tunnel syndrome (CTS) is one of the most talked-about and worst offenders, but most computer users brush it off, saying that it's too bad a few people have it. The truth is that many thousands suffer from CTS, and if it were taken more seriously, we'd get to its root cause: the praying-mantis speed-typing position used on a computer keyboard. This kind of speedy touch-typing is still taught in schools, and while it works fine on an old typewriter, it is inappropriate on a hard, flat computer keyboard. The constant pounding takes its toll.

Only recently have keyboard makers done anything about the unacceptable keyboards we're forced to use. With the introduction of the fancy Apple keyboard that breaks apart and the new Microsoft keyboard, more human-friendly designs are finally being seriously considered. This despite the fact that many companies, including Applied Learning Corp. (215-688-6866), Ergonomixx (703-771-1047), Health Care Keyboard (414-253-4131), and Kinesis Corp. (206-455-9220), have offered alternatives to the standard keyboard for years. The difference is that the newer varieties are much less expensive.

I go through many different keyboards, trying just

about every design I can lay my hands on. Having used a variety of keyboards, I can attest that some work better than others. Tendinitis is to be avoided like the plague, and it's sometimes caused by repetitive stress. Banging on a hard keyboard all day will do it. While tendinitis seems trivial, it's painful and disabling—if only for a few weeks. To avoid it, since I do so much writing, I generally use a keyboard for a few weeks and then switch to a different one with a different feel. I advise that for everyone. And note: You've been warned about mouse shoulder too.



One day while reaching for the mouse, I realized the cause of my pain. Owwww! Mouse shoulder.

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CIRCLE 177 ON READER SERVICE CARD

Inside Track

T

he Never-Ending Story Dept.: About the time you read this, the IEEE International Electron Devices Meeting is being held in San Francisco. It's one of those events where the **true wizards** of the world get together to discuss current research in

detail. These are the events I like to attend to get a good window-seat **view of the future**. While this kind of event highlights **raw** research, many (if not most) of the developments find their way into products sooner than later.

Some developments worth noting. Expect to see the **low-power** 3.3-volt device drop to 2.5 volts soon, then to 1 volt! AT&T Bell Labs is presenting a paper showing how tilting a wafer 60 degrees during boron implantation eliminates boron penetration in the polysilicon gate area, allowing lower-voltage (1-volt) design. Folks, when these people are through, we'll be running desktop computers on **watch** batteries.

Intel is there to discuss the trend toward a **sub-0.2-micron process**. I thought that was boggling until reading the Matsushita report of the **smallest CMOS process ever developed**—a 50-nanometer process utilizing an ion implantation technique (a nanometer being a billionth of a meter or 0.05 microns!). It doesn't take a genius to see where things are headed. It's **frightening**.

In the realm of **flat panels**, there's work being done to get us out of the costly active-matrix LCD world. The technology to watch is called **field-emitting displays** or FEDs. Japanese companies, which I believe have never seriously profited from expensive active-matrix LCDs, are doing most of the work in this area.

What about memory technology? Glad I asked. The major target in this area is clear: the **1-gigabit DRAM chip**. NEC is presenting a paper on the first practical 1Gb DRAM capacitor structure. Another team from NEC is describing the smallest capacitor cell area ever reported, again for the 1Gb chip. According to the researchers, this gigabit chip will be on the market and in machines **before the year 2000**. This one chip will hold more than 100 full books of text. It should be perfect for the **bloated code** of the future.

Another significant event is being presented by Nichia Chemical Industries, which describes a bright (1-candela) **blue-light laser**. This development may finally bring us the fabled blue-light CD-ROM. In theory, it's possible to quadruple the capacity of a CD-ROM by using a blue-

In the area of flat panels, there's a lot of work being done to replace costly active-matrix LCDs. Watch for field-emitter displays (FEDs). Japanese firms are doing most of the work in this area.

light laser, but nobody has come forward with an adequate blue-light laser technology for such an implementation. This could be it.

Back to Earth Dept.: Meanwhile, back on earth we see that NexGen has released its version of the Pentium/586. I was **depressed** to see that the first rollout was a chip with **no floating-point processor** on-board. Unacceptable. Software designers have to be assured that the floating-point capability of today's chips is always available. You can't imagine the moaning that took place over the 486SX. I believe users should **reject systems without floating-point capability**. It's **ridiculous** in this day and age to sell a microprocessor without a built-in floating-point

function. Sheesh, can you spell *graphics*?

The Best-Kept Secret Dept.: I had a meeting with a CEO of a major connectivity company working with drive vendors. He says flatly that we can expect to see a **flurry** of writable CD-ROM drives within the next 12 to 18 months **selling for around \$300**. Wow. Apparently there have been breakthroughs, and we may all be using writable CD-ROMs sooner than anyone thought. They're a good medium for archives and backup. Or so it seems. With 9GB hard disks around the corner, we'll soon be complaining how it takes 13 or 14 CD-ROM disks to back up the system. Does anyone see a pattern here?? Complaining is the key word.

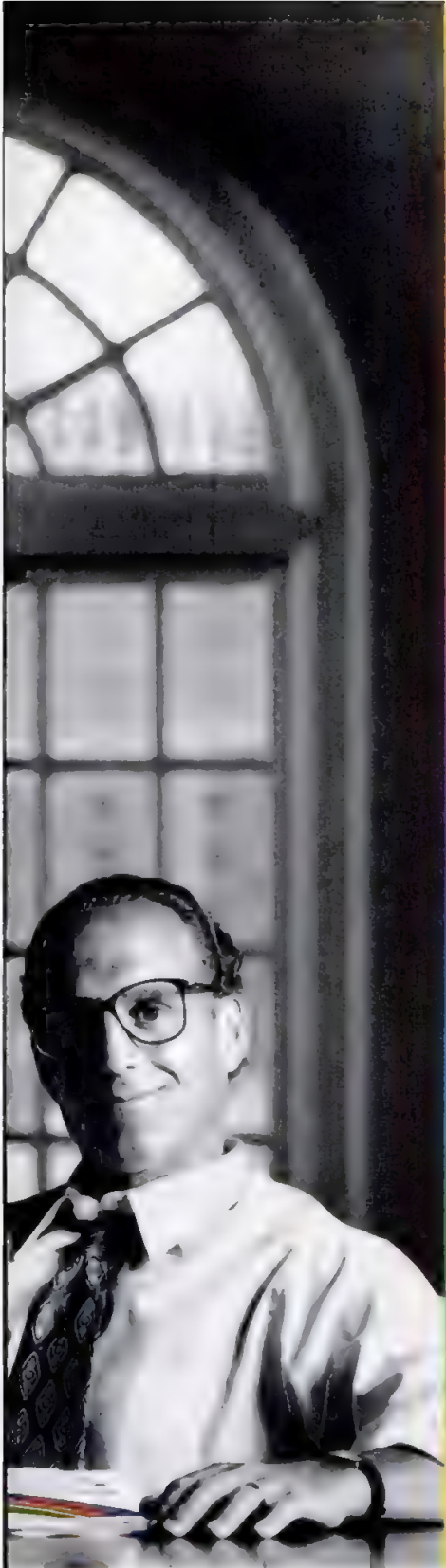
The Dummies Phenomenon Continues Dept.: While jokes abound concerning the offbeat naming of Microsoft Windows 95 ("That means it will only be 95 percent complete when it ships," is my favorite), apparently some research went into the name. **The research is distressing**. According to an article in *Advertising Age*, "Microsoft market research determined that most PC users were confused by the old engineer-inspired product labelling." In other words, those **wacky** numbers such as 3.0, 3.1, and 3.11 were confusing. "They couldn't identify the latest rendition of Windows." Gee, it's so so so difficult! Does the word "Duh!" come to mind?

Preoccupied Dept.: So Apple's VP, Ian Diery, is giving a lecture about "the coming Wintel Rupture." Wintel refers to the Windows-Intel axis, and the rupture is what he predicts will happen when the CISC world is overtaken by RISC technology (yawn). Anyway, it seems that Diery is an avid rugby player and equestrian. "No wonder he's preoccupied with ruptures!" quipped one editor.

Hey, the way I figure it, a marketing theory based on sports injuries is as good as any! □



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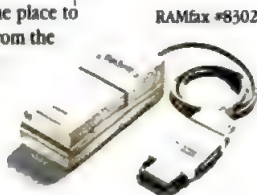


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Jim Seymour

The Notebook Conundrum

Sometimes trends and technology get out of sync. That's happening now with notebook PCs and our expanding use of them. Users are getting squeezed between the slowly climbing notebook-power curve and the much steeper notebook-adoption

curve. The result is that there's a risk of turning notebook users into second-class citizens over the next few years. Don't let that happen to you.

You might complain that the rate of technological change in notebooks is too slow. Still, color displays are killing off obsolete monochrome units; CPUs are getting faster, and RAM capacity is growing.

The problem is, desktop PCs are getting better even faster.

Or you could complain that desktop PCs are ahead of notebooks in the power race. Old news. Desktop PCs always get the newest stuff first, because their designers aren't facing the size, heat-dissipation, and power-draw problems faced by their colleagues. Notebook producers are closing the time lag for the appearance of portables built around new technologies, but portables still lag behind desktops by about a year.

That's never been quite as important as it is today.

Over the next two or three years, we're going to see a striking increase in the functionality users demand from their PCs. New demands, from extensive use of client-side applications in client/server architectures to PC-based videoconferencing, sop up MIPS and bandwidth—both in short supply on notebook PCs connected to the Mother LAN via dial-up phone lines.

Yet this explosion in our demand for more power and greater connectivity bandwidth is happening at exactly that moment when more and more PC users are turning away from desktop machines to notebooks.

For some, this change is spurred by their employers' desire to get many more workers out of the office. These workers may still come into the office on occasion, using a "hoteling" arrangement for temporary office space. Yet wherever

they're working, these employees need fully functioning PCs. Ergo, notebooks as the machines of choice.

For others, the shift to notebooks happens because it's time for a new PC, and their companies no longer provide for both a desktop *and* a portable. They choose—or are given—notebooks as their only PCs. Constant mobility isn't a requirement here; but even if you want to work away from your desk only once in a while, you need a notebook, because using a desktop means you're *never* able to take it with you.

Finally, the change to notebooks may happen simply because, while you work at a desk full-time, your company is cutting back on individual workspaces. Though less publicized than the get-'em-out-of-the-office trend, this one's gaining momentum, as companies reengineer everything from their production lines to their floor plans.

Unlikely? Have you ever been in an office in Japan? There, even midlevel professionals and managers work nearly elbow to elbow. Portable PCs have dominated the Japanese office since Toshiba's AC-powered laptops appeared almost a decade ago; Japanese offices simply don't have enough office space or desk space to accommodate that many workers using full-size PCs.

OUT OF THE GHETTO

When only a few of us relied on notebooks, often as portable extensions to our desktop machines, it was acceptable to marginalize notebook users: They just didn't count that much. Now though, with notebook users in the majority in many departments and at some entire companies—and with the balance steadily tilting in favor of notebooks throughout American business—it's no longer permissible to ghettoize the notebook user.



With notebook PCs, the trend toward adoption far exceeds the growth of the technology.

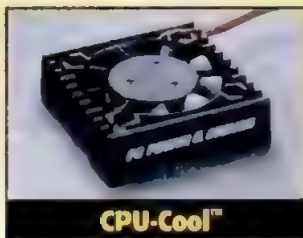
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CIRCLE 080 ON READER SERVICE CARD

Jim Seymour

So what does this mean for the business-PC buyer?

First, buy at the high end of the notebook-power curve. The new Pentium-based notebooks will have a substantially longer useful life, I suspect, than machines built around older, slower processors—and that longer life can more than make up for the higher price of these boxes.

Put enough RAM in the machines and a large enough hard disk to match typical desktop PCs in your company. Settling for 4 megabytes of RAM is silly; install at least 8MB, and consider 12MB to 16MB if users will be running several applications at once. Reasonable hard disk sizes start at 300MB.

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Second, be realistic about the probable useful life of *any* notebook PC you buy today. Most of my corporate clients project an 18-month life cycle for notebooks now—and know they may be replacing them even sooner. Don't make useful-life cost-justification arguments today that you'll regret within a year or eighteen months.

Third, if your company is considering rolling out new, power-hungry PC services, consider the likely ratio between desktop and notebook PC users in your company one, two, and three years out. If, by the time those services are ready, a significant number of the computer users in the company are on notebooks and will be able to use less than 100 percent of the functionality of those services, somebody's going to be in hot water.

Fourth, pray for improvements in our national telecom infrastructure. Much of our use of notebook PCs in the years to come will rely on connections over phone lines, but the bandwidth of the current dial-up network is far too feeble, and the spread of ISDN lines and other improvements is likely to be way too slow to end these bottlenecks without drastic upgrades. □

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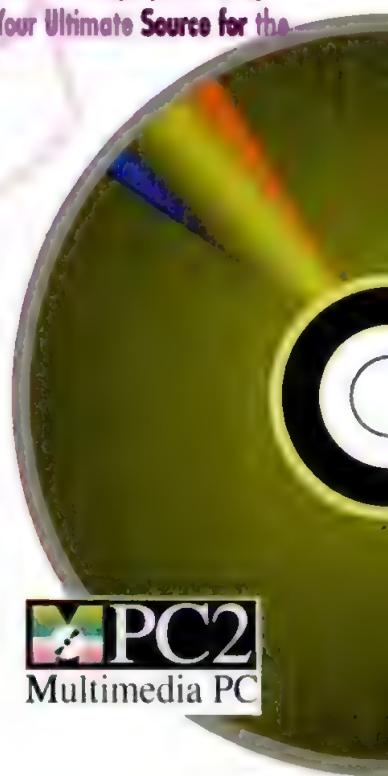
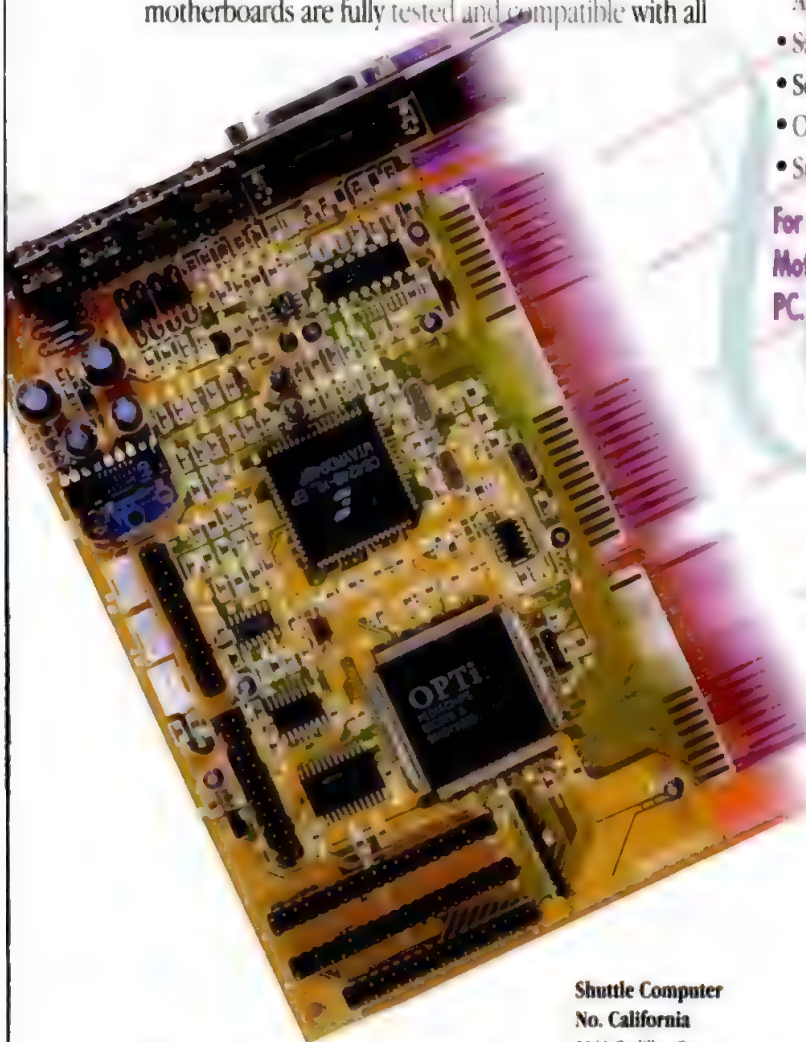
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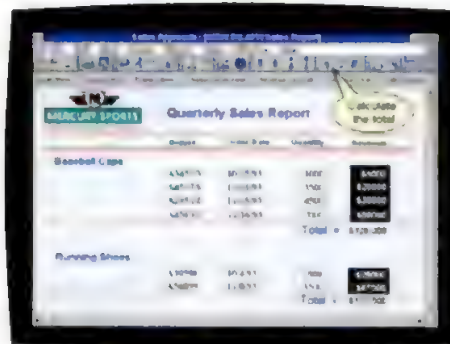
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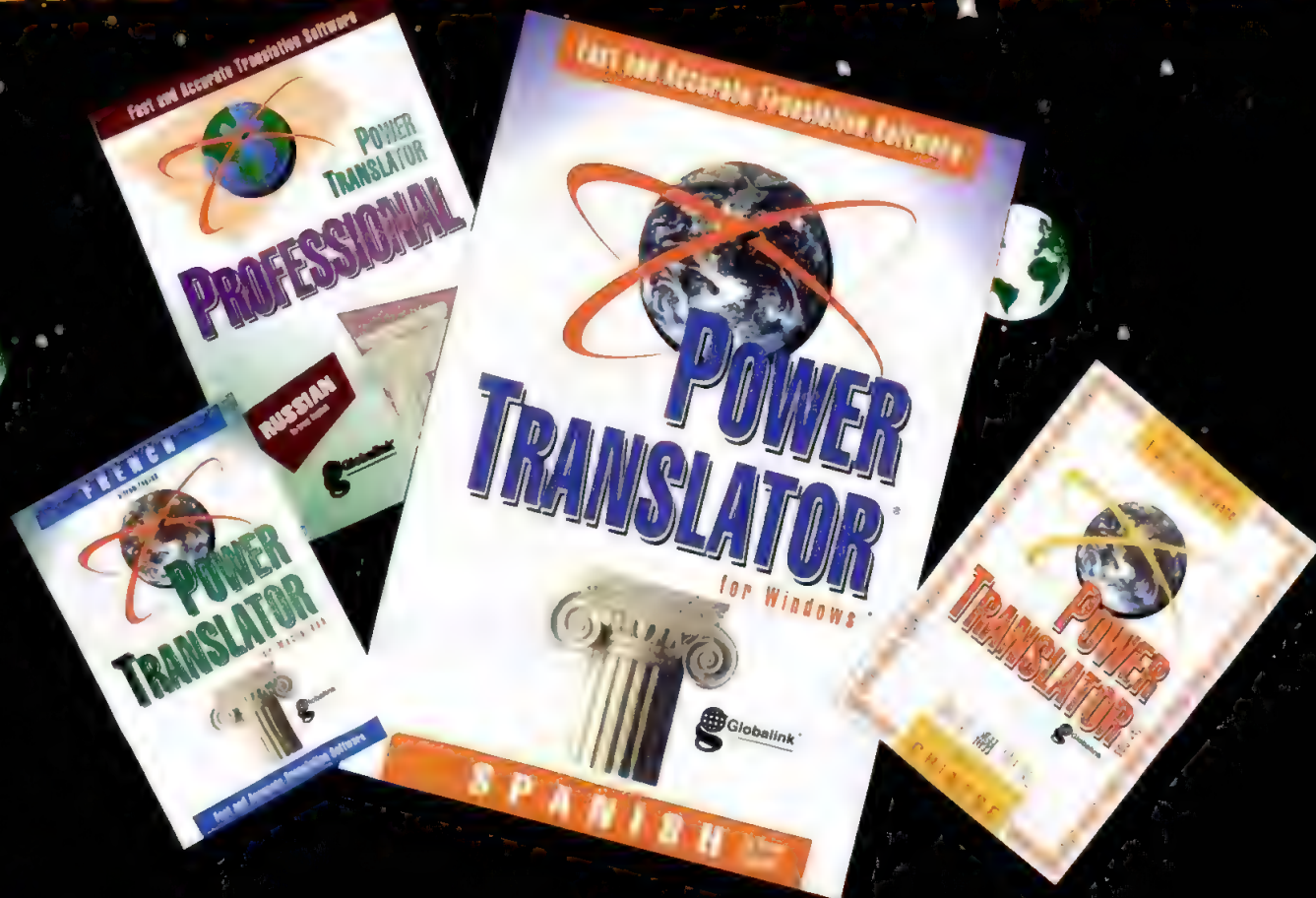
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Bill Howard

All's Quiet on the CPU Front

Moore's Law hasn't been repealed, but it will be lying low the next few months. Intel cofounder Gordon Moore said 25 years ago that the number of transistors in a microprocessor—a rough measure of power—doubles every 18 months. He's

been right about that all along. Obviously, it's not a steady procession of CPUs comprising 4 percent more transistors every month that, with compounding, doubles your transistor count and processing power every year and a half. Instead, there are quiet periods when not much happens, followed by great leaps forward.

Right now we're in a still period. You may not see any significant processor performance improvements among Intel-compatible PCs for the better part of a year. You'll see plenty of new CPUs in the next year, just nothing that moves us to a different performance level. The heavy-hitting CPUs aren't expected until well into the second half of 1995: the 132-MHz Pentium and the Pentium-successor P6, with roughly 6 million transistors to Pentium's 3.2 million.

In the meantime, what you'll see are processors that bracket the 90-MHz Pentium, plus or minus 15 percent on performance. From Intel, you'll see a 75-MHz, 3.3-volt Pentium and a 100-MHz variant of the high-end Pentium/90 (due in quantity in the first quarter). From AMD, Cyrix, and NexGen, you'll see Pentium-class competitors, the K5, M1, and Nx586P90, respectively. A 15 percent performance boost, however, is just not that exciting.

So the second half of 1994 and the first half of 1995 will be a repeat of what we experienced two years ago (mid-1992 to mid-1993): a year when the CPU clock stood still. Last time it was the 486DX2/66; this time it's the Pentium/90.

Here's what I believe will happen through the first half of 1995.

- **The Pentium/100 will be a nonissue**, just as the Pentium/66 has been a nonissue relative to the Pentium/60: By the time the chip was viable, something even faster was already on the horizon.
- **The Pentium/75 will be**

the CPU to watch. While you can't tell a Pentium/60 from a 486DX4/100 on performance, the Pentium/75 should stand out. This will be the midrange CPU of choice, with the 486DX2/66 holding down the low end. Within companies that reflexively buy the second best for their employees, the Pentium/75 will be a good deal all around. Also, it's a 3.3-volt CPU, so it runs cooler and can be put into an Energy Star desktop PC, if that's your cup of tea. In laptops, its initial target, you'll have performance on a par with that of most desktop PCs.

• **Clone CPUs keep price pressure on Intel.** Assuming they work as advertised, AMD, Cyrix, and NexGen will force Intel to price its 90-MHz and faster CPUs competitively, not just the Pentium/60s. Six months ago, I thought it was the PowerPC that would be Intel's biggest thorn; now, unless IBM gets its act together, the PowerPC looks like a Mac-only show, making the PowerPC essentially a supercharged RISC 68040 driving a friendly user interface.

• **I/O subsystems help performance.** Drive and graphics subsystems will continue to make progress. You know how much faster graphics boards have become in the past two years. Now keep your eye on a drive technology called PRML. It sounds like the indicator on an automatic transmission; actually it stands for Partial-Response Maximum-Likelihood disk-read-channel technology and combines digital sampling and DSP techniques to allow more data and far faster transfer rates.

Vendors can use this relatively calm period to work on the stability of their system designs, to get Plug and Play working at last, and to get ready for Microsoft Windows 95. So everything will be quiet but not too quiet. CPUs are not the only things that make PCs fast. □



Don't look for significant advances in CPU performance until the second half of next year.

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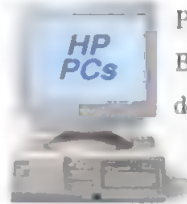
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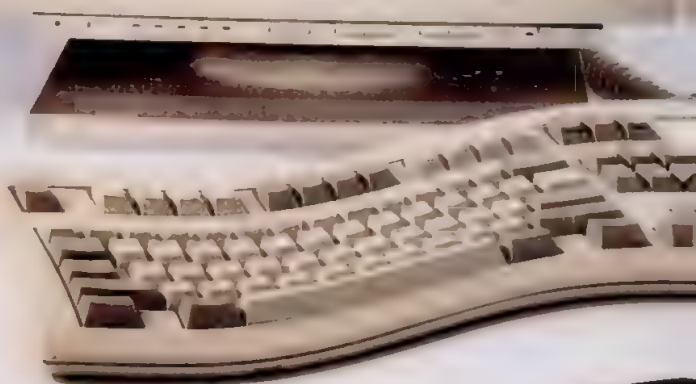
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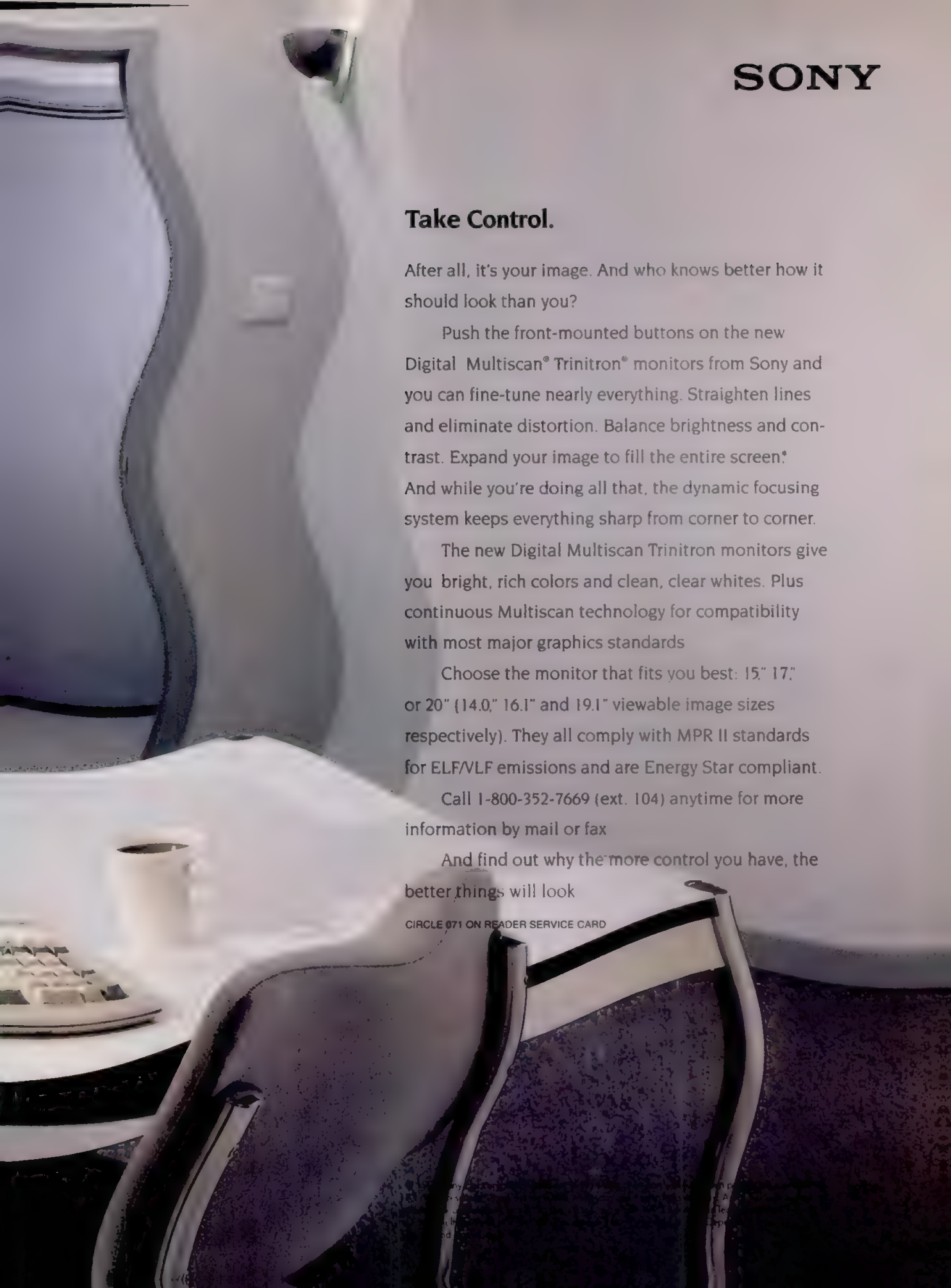
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P E N T I U M V S . 4 8 6

For Love or Money

The machine you really lust after is a 90-MHz Pentium. But your wallet says buy a 486. Can't decide? PC Magazine Labs tests 165 entry-level, midrange, and high-end PCs to help you choose.

By Bill Howard

What a difference a year makes! In the span of the past 12 months, we've seen the arrival of the Pentium processor coupled with ferocious price erosion—so you're getting twice the performance for the same price, or the same performance for 40 to 50 percent less than in 1993.

Welcome to *PC Magazine's* annual review of PC lines. For this issue, we asked every PC vendor to send us up to three systems from each of their product lines. A year ago, a PC line typically meant three variants of the same 486 motherboard. This year, the low end is a 486DX2/66; the midrange is a Pentium/60, Pentium/66, or DX4/100; and the high end is a Pentium/90. All told, we acquired 165 systems representing 66 lines from 55 ven-



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dors for this roundup.

What we found was a combination of the expected and the surprising. Systems fell into three broad performance categories, aligning with the three processor/configuration tiers. Within each category, the difference between any two systems could be noted with a stopwatch or a benchmark test. But excepting the bottom-dwellers in each tier, we think you'd be hard-pressed to say that one system in a tier clearly runs faster than another just by scrolling through a long document or by hitting the page-preview button.

And that leads to a key point: These 165 PCs have some *commonality* of performance and features, but they are far from *commodity* products. What sets a system apart is its fit and finish, the capacity of its internal components, the service and reliability reputations of its vendors, and its price. Although this last item is a central consideration for many buyers, it's important not to get too hung up on the last few hundred dollars. That's pocket change compared with the actual cost of keeping a PC on the desktop for five

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40 Pentium/90 systems

years, which runs into the tens of thousands of dollars when you include training, ongoing support, network administration, software, and repairs and upgrades.

WHAT TO BUY

Buyers today face a dilemma: Most of us know that 486-class systems are relics—or will be within a year of purchase. We're skeptical of the hot-running 5-volt Pentium/60 and Pentium/66 systems. That leaves Pentium/90 machines; yet many of us work in companies where there's a

built-in bias against buying the newest technology. They think it's wasteful, like buying Coupe de Villes for company fleet cars instead of Tauruses.

Our opinion: The smartest choice for virtually everyone today is a Pentium/90 PC. Equipped the same as a Pentium/60 system, the price difference may be as little as \$250 to \$300. More likely it will be \$500 to \$1,500, because you're apt to match a Pentium/90 with a bigger hard disk, more memory, a hotter graphics card, and a larger monitor. Right now you can buy a Pentium/90 system for as little as \$2,500, a Pentium/60 system for around \$2,000, and a 486DX2/66 system for less than \$1,500.

If you opt to slide down the price-performance scale to the midrange, look at the DX4/100 systems in addition to the Pentium/60s. Despite Intel's disaffection for its less-than-one-year-old offspring, the DX4/100 matches the Pentium/60 in overall system performance. Because they're based on 3.3-volt technology, the DX4/100s run cool, and they can also meet the EPA's Energy Star specification for idling at less than 30 watts. You prob-

HIGHLIGHTS

Pentium and 486 PCs

THESE 165 SYSTEMS span the spectrum of performance in three categories, from entry-level 486DX2/66-based systems to powerful 90-MHz Pentium PCs. About \$1,000 separates average system prices for each of the three performance tiers: Entry-level systems equipped with 8MB of system memory and 486DX2/66 processors average about \$2,200; midrange systems with 16MB of RAM and processors ranging from DX4/100s to 66-MHz Pentiums average \$3,150; high-end systems with 16MB of RAM and Pentium/90 processors average about \$4,000. We didn't test 100-MHz Pentium systems for this roundup, because these chips are still not shipping in volume.

PERFORMANCE DIFFERENCES

between the three tiers are large enough to be noticeable, although the

high-end systems and midrange systems posted benchmark test scores that were somewhat close together in many cases. Differences in performance between entry-level systems and the other tiers are much more dramatic: Pentium/90 machines as much as double the performance of 486DX2s. DX4/100 systems performed roughly on a par with Pentium/60 and Pentium/66 machines.

PCI IS QUICKLY DISPLACING VL-BUS

as the high-speed expansion bus of choice in new machines. Systems in this review with PCI buses outnumbered those using a VL-Bus design by a margin of two to one. Despite their lackluster performance, OPTi chip sets can still be seen in some systems; they help manufacturers hedge their bets by offering machines with both VL-Bus and PCI.

IDE STILL BEATS SCSI when it comes to performance under Microsoft Windows. Now that Enhanced IDE has broken the 528MB disk-capacity barrier, even high-end systems are equipped with IDE hard disks.

IN THE FUTURE we expect to see Pentium/60- and Pentium/66-based systems fading in prominence, to be replaced by Intel's recently announced Pentium/75 processor. Although these new Pentiums are aimed primarily at the notebook segment of the computer market, we expect to see them in desktop systems as well—especially in inexpensive home-oriented multimedia PCs. Both 486DX2 and DX4 processors will soon be relegated to the bottom rung of the performance ladder, but they will continue to be a terrific value choice.

ably won't see DX4/100s selling for much less than Pentium/60s, because Intel would just as soon the 486 market died. To that end, it's been aggressively pricing Pentium/60 CPUs; savvy customers can buy them in quantity for as little as \$350.



REVIEW CRITERIA

For this roundup of desktop PC lines, we sought PC systems that were shipping as of late summer. To be included, vendors had to have a national presence, meaning you can buy their products throughout the U.S. and much of Canada.

We asked vendors to submit up to three PCs to represent each of their product lines—a *line* being defined by a vendor's marketing strategy. For a company like Compaq, that breaks down into high-end desktops (the Deskpro line), value-line desktops (ProLinea), and home-oriented systems (Presario).

Here's how we defined the three performance levels within the lines:

- **High-end** systems based on Intel's 90-MHz Pentium CPU. (Pentium/100 systems aren't expected until early 1995.) We asked that they be equipped with 16MB of RAM—no more, no less—and a 700MB (or larger) hard disk. We received 49 high-end systems.

- **Midrange** systems based on the 60- or 66-MHz Pentium or the 100-MHz DX4 CPU. We asked that they be equipped with 16MB of RAM and a 520MB or larger hard disk. We received 59 systems: 12 DX4/100s, 19 Pentium/60s, 28 Pentium/66s, and one IBM Blue Lightning 25/75 that straddled the boundary between entry-level and midrange in terms of performance.

- **Entry-level** systems based on Intel's 66-MHz 486DX2 CPU or roughly equivalent CPUs from AMD, Cyrix, or IBM. Reflecting the way they're likely to be purchased, we only asked for 8MB of RAM and a 340MB or larger hard disk. We received 56 systems—all but one of them with an Intel CPU. (The exception was an IBM 486SLC2/66.)

All systems had to have a monitor, mouse, DOS and Microsoft Windows installed, a floppy disk drive, and CD-ROM drive. With prices for entry-level CD-ROM drives falling toward \$100, we think they belong in every PC. Vendors were

High-end (performance/features-oriented):

- **Insight PCI P90 MM**
- **ZDS Z-Station EX**

High-end (value-oriented):

- **Dell Dimension XPS P90**

Midrange:

- **No Editors' Choice**

Entry-level:

- **NEC PowerMate 466D**

Among high-end systems—those with Pentium/90 CPUs—two machines stand out by providing an impressive combination of performance and features: The \$4,799 Insight PCI P90 MM and the \$5,327 ZDS

Z-Station EX. The Insight system is notable for both its speed and its exceptional array of components, which includes a graphics card loaded with 4MB of VRAM, a quadruple-speed CD-ROM drive, a sound board, a 17-inch monitor, and a 14.4-Kbps fax modem. Housed in a hulking tower case, the Insight P90 is also extremely expandable.

The ZDS EX distinguished itself with a second-place score on our Winstone 95 tests. ZDS offsets the lesser expandability of a slimline case by integrating a number of components, including an Ethernet interface and a speedy ATI Mach 64-based graphics adapter with 2MB of VRAM. One caveat to consider before buying is ZDS's below-average rating on our service and reliability surveys.

The Dell Dimension XPS P90 earns an Editors' Choice for providing an exceptional price-performance ratio. Priced at \$3,149, it's one of the least-expensive high-end machines we tested—yet one of the fastest.

Entry-level systems are clustered tightly in price, performance, and features, but NEC's PowerMate 466D edges out the rest by virtue of its strikingly fast Microsoft Windows performance and competitive \$1,754 price.

We aren't awarding an Editors'

Choice to a midrange system—one based on a DX4/100, Pentium/60, or Pentium/66 CPU—because we think you'll be served better by going for an extreme of price and performance. Pentium/60 and Pentium/66 CPUs are nearing the end of their lifespan, and the future of the DX4/100 is uncertain. If you're looking for rock-bottom prices, 486DX2/66 systems can't be beat; if you want speed and long-term viability, a Pentium/90 is the right choice.

HONORABLE MENTION

The \$3,195 ZEOS Pantera Pentium-90 is outstanding—an Editors' Choice contender in every respect but one: It can accept a full-length expansion card only in its shared PCI/ISA slot. For many users, this won't be a concern and the ZEOS Pentium-90 will make an excellent buy; however, it's a design sacrifice that we feel is unnecessary.

We also award honorable mentions to two midrange systems: the Pentium/66-based \$3,999 Insight PCI P66 MM and the DX4/100-based \$2,928 Micron 4100PCI Magnum. The Insight P66 is somewhat expensive, but it outperformed many of the 90-MHz Pentium systems that we tested; the Micron 4100PCI is an excellent performer for its price.

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TabWorks®, and Network Interface Drivers



Compaq Deskpro XE 466

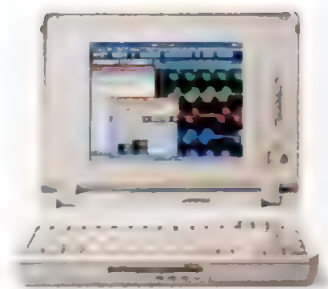
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Deskpro XE Features:

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(others available, including Pentium)
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♦
270MB Hard Drive
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3.5" 1.44MB Diskette Drive
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QVision Local Bus Graphics
with 1MB VRAM
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SVGA Color Monitor (1024 x 768)
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170MB Removable Hard Drive (340MB available)
♦
Two PCMCIA Type II slots (or one Type III)
♦
3.5" 1.44MB Diskette Drive
♦
Color VGA TFT Display
♦
Local Bus Graphics
♦
Built-in AC Adapter and Trackball
♦
Preinstalled MS-DOS 6,
MS-Windows 3.1, TabWorks, and
Microsoft® Video for Windows (Runtime)



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and 10.25" x 7.5" x 1.5"
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Contura 400C Features:

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- +
- Color Dual Scan Display
(Color TFT available)
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- +
- Only 5.9 lbs.
- +
- Preinstalled MS-DOS 6,
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TabWorks, and Lotus Organizer

The new
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Contura

Or \$92 per month*

400C is an affordable, lightweight color notebook that's packed with practical features such as an integrated centered trackball, convenient wall-mount AC adapter, tilting full-function keyboard, PCMCIA slots, a clip-on carrying handle, and optional docking base.

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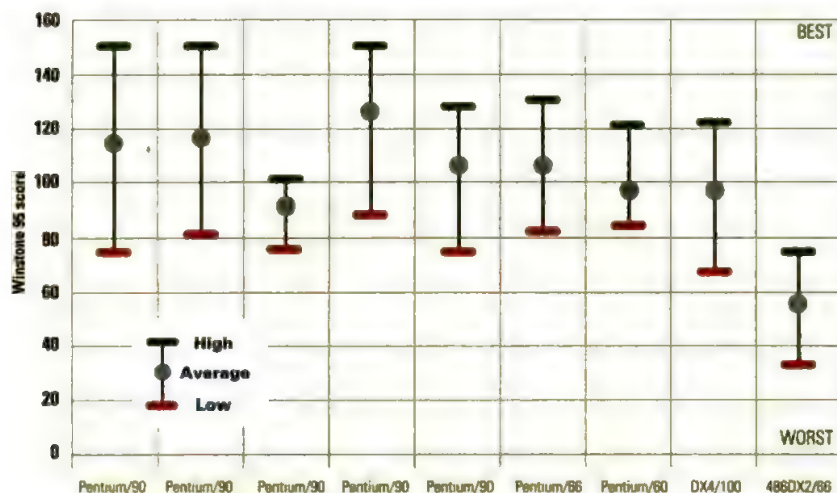


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It's no surprise that Pentium/90 systems led the pack on our Winstone 95 tests. But take heed: Pentium/90 machines with OPTI chip sets and those with SCSI hard disks did not fare well.



invited but not required to include sound boards, speakers, fax modems, and network adapters. They were free to send us a desktop or tower case.

Our testing targeted the applicability of these systems for desktop use under the mainstream operating environments (DOS and Windows). Though many could serve adequately as workgroup file servers, our tests were not geared for that purpose. For file-server tests, vendors probably would have wanted to configure the units with bigger hard disks and less-powerful graphics adapters.

We didn't ask for 486SX/33 or 486DX/33 systems, because we believe there's no point to them beyond allowing for "486 PC, \$995 Complete!" teaser ads. Yes, they'll run Windows apps adequately today—after all, a 486/33 is what many

of us have on our desktops. But they're going to feel unbearably slow in a year or two, less than halfway through their amortization cycle. Furthermore, 486/33 systems are typically mated to slow graphics chips, small hard disks, and inadequate amounts of memory (4MB or less).

NEW BENCHMARK TESTS

With this issue, we introduce a new set of benchmark test suites: Winstone 95, WinBench 95, and PC Bench 9.0, created by the Ziff-Davis Benchmark Operation (ZDBOp). Winstone 95 provides a measurement of systems' real-world Windows performance running 13 best-selling Windows applications. In addition to the overall Winstone score, there are now break-out Winstone scores for four application categories: word processing, spreadsheet,

database, and business graphics/desktop publishing.

WinBench 95 measures the performance of the graphics subsystem through the Graphics WinMark 95 tests and disk subsystem performance through the Disk WinMark 95 tests. PC Bench 9.0 measures performance under DOS. (Note that the former Processor tests are now known as the CPUmark₁₆ tests.) For the first time in a review of this size, we also tested CD-ROM drive subsystems.

Because our tests are recompiled and reweighted each year, there's no magic multiplier that lets you compare a past year's Graphics WinMark score to a new Graphics WinMark 95 score. We've added the "95" appellation to most test names so you know we're talking about the current tests. An excellent Graphics WinMark 95 score is in the low teens (it was in the high 30s for the 1994 Graphics WinMark test); if you see a vendor quoting a significantly higher WinMark score in 1995 and the test doesn't identify the year, it's likely the vendor is using older tests.

The tests developed by ZDBOp are available free; for more information about them or how to receive them, see the Lab Notes column "Reaching New Heights in Benchmark Testing" in the back of this issue.

PERFORMANCE RESULTS

The overall performance of our three groups of systems, as measured by Winstone 95, fell into three tiers corresponding with the three processor/configuration levels we specified. Entry-level systems were four to six times as fast as our reference machine—a Compaq Deskpro

In Short and Service & Reliability Ratings: Pentium and 486 PCs

Our **In Short** statement conveys our impressions of the entire product line—what its distinguishing features are and what markets it's targeted toward.

SERVICE AND RELIABILITY

In our 1994 Service and Reliability Survey, we sent questionnaires to 17,000 random subscribers; about half of those subscribers replied. Vendors for which we received at least 50 survey responses—the

minimum required for a statistically reliable sample—are rated as *above average*, *average*, or *below average* in three areas:

Reliability scores indicate to what degree computer owners felt their systems met their overall expectations for consistent operation.

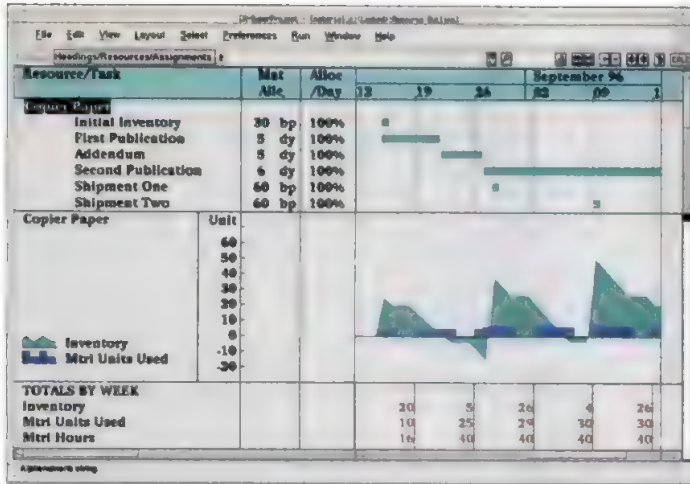
Repair service scores are culled from those users who contacted the vendors to have their PCs repaired. The scores reflect users' satisfaction with the service they receive.

Technical support scores measure how well vendors' telephone support met respondents' expectations.

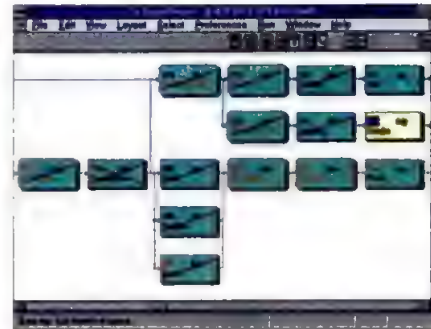
In the AT&T Globalyst review, we include service and reliability scores for NCR, which developed these machines before being acquired by AT&T.

For more information on survey methodology and results, please refer to our July 1994 issue.

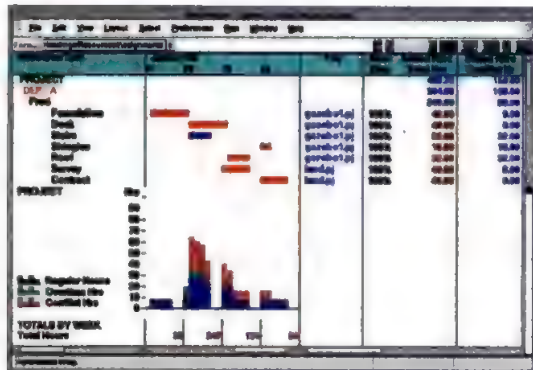
IN SHORT	
Product Line	
Moderately priced, high-performance multimedia PCs for home users.	
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	BELOW AVERAGE



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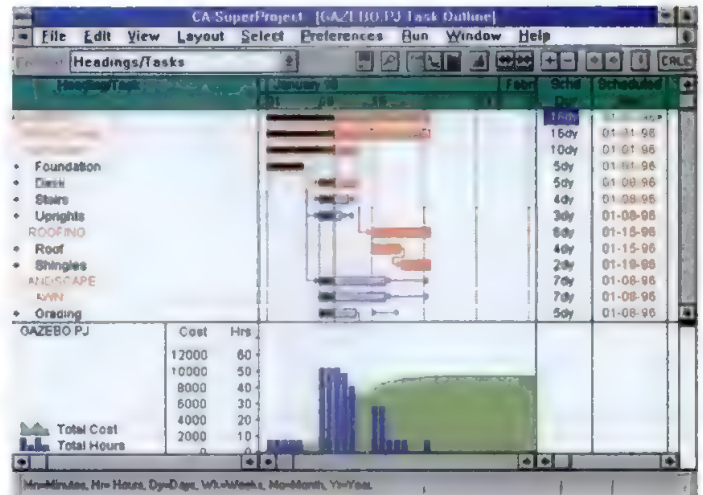


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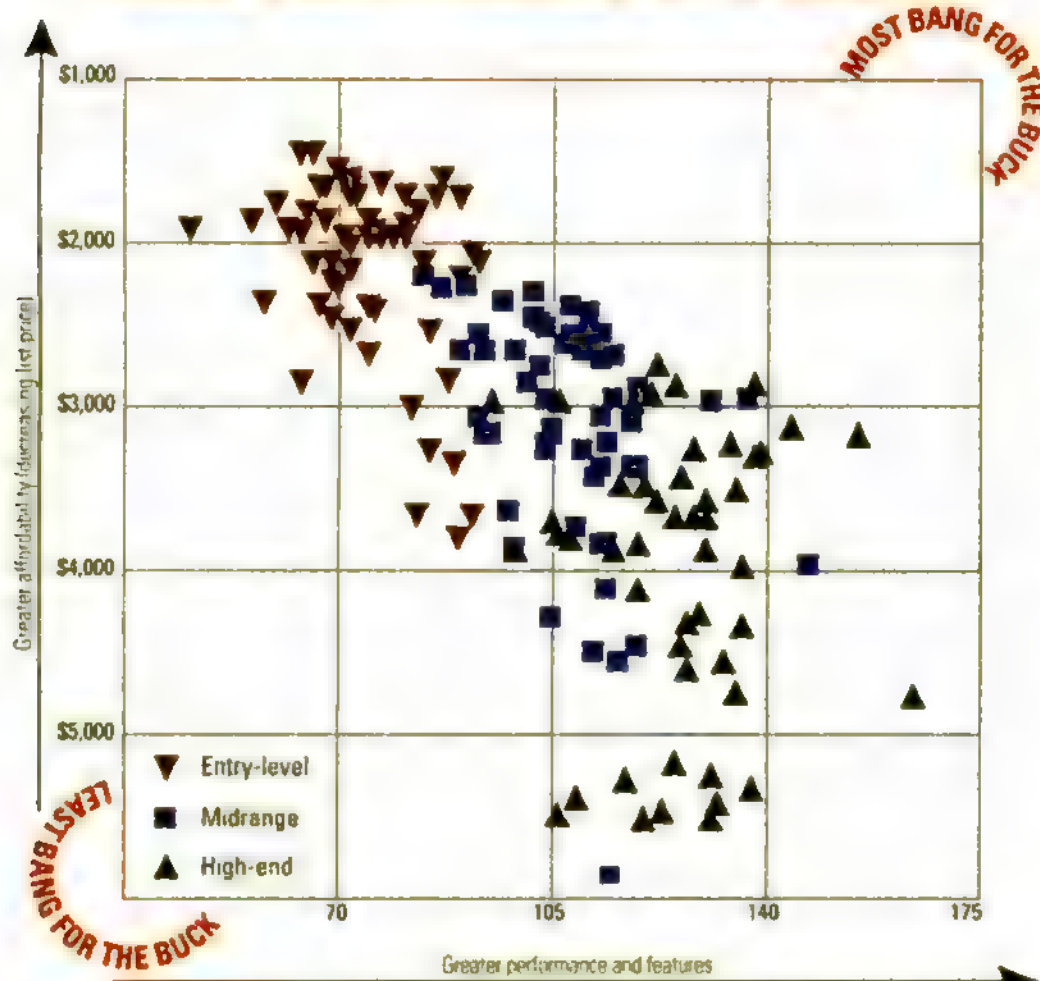
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Price Performance at a Glance



Entry-level PCs are clustered, while midrange and high-end systems overlap. Look for a detailed price/performance chart in this issue's gatefold.

386/25. The midrange was almost twice as fast as the low end, and the high end was 10 to 15 percent faster than the midrange. If you look only at CPUmark₁₆ (processor) scores, you'll see broader variations.

On our Winstone 95 tests, the fastest entry-level system was slower than the slowest midrange system. That's because we tested entry-level systems with 8MB of RAM, versus 16MB for the midrange and high end. Adding a second 8MB bank of RAM is worth at least a 15 to 20 percent performance improvement. On the average, entry-level systems also had lower-performance graphics adapters.

We found that there was significant overlap among midrange and high-end systems—proof that there's more to designing a good computer than just dropping in a fast CPU. Intelligent selection of components and subsystems plays a big

role, too. When one thinks of components that speed up a PC, the graphics adapter comes to mind first. (For reviews of 54 graphics accelerator cards, see "Rush Power" in this issue.) But we've found you also have to pay attention to the drive subsystem if you want great performance.

Our testing continues to find that IDE drives significantly outperform SCSI drives. The high-end Pentium/90 systems were evenly split between Enhanced IDE and SCSI units, yet the IDE-based systems were almost 20 percent faster. SCSI is not without its charms: You can attach multiple internal and external hard disks, CD-ROM drives, and scanners to a single SCSI adapter, for example. It's also quite possible—but not guaranteed—that SCSI will blossom under true 32-bit multitasking operating systems such as Windows NT, OS/2, and Unix. If that's true, then SCSI does represent a smart bet for the future. But for today's systems running under Windows, Enhanced IDE is the performance choice.

We also observed a continuation of the trend among high-end systems we noted a few months ago: The 42 Pentium/90 systems using Intel's Neptune chip set were almost 30 percent faster under our Graphics WinMark tests than the 7 units using the OPTi PTM3V chip set. The

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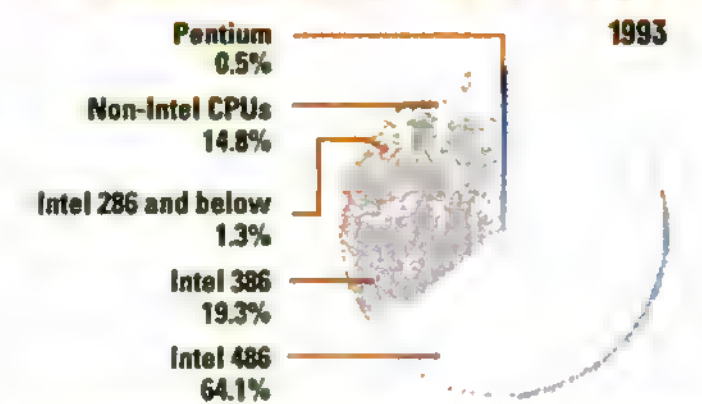
OPTi chip set allows systems to have both PCI and VL-Bus high-performance buses, but for Pentium PCs, we believe the future belongs to the PCI bus. If you're buying a 486-based system, either bus is adequate—but PCI-based expansion cards are now widely available, and there's no longer any significant savings with VL-Bus.

We take a dim view of one final way to improve system performance: tampering with the clock frequency. For a previous review, Personal Computer Graphics Corp. sent us a 90-MHz system overclocked to 108 MHz that promptly suffered a CPU meltdown. This time we got a 90-MHz PCG system overclocked to 100 MHz and a 66-MHz 486DX2 system overclocked to 80 MHz. (PCG's Pentium/60 appeared kosher.) We rate the systems "not recommended," because we don't think hot-rodded systems are reliable (assuming you got yours built the way we did) and because we're frankly annoyed that anyone would think the tech staff at ZD Labs and PC Labs would manage to overlook the stepped-up CPU speed.

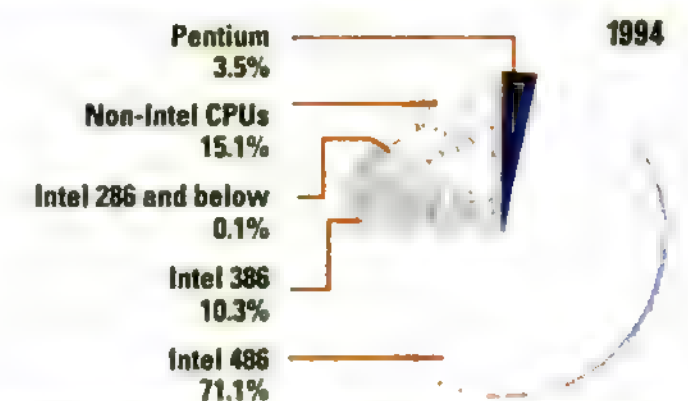
FEATURES: WHAT'S HOT

How does the typical PC compare with what you bought a year ago? Of course, it's faster and cheaper. A 400MB to 500MB

U.S. Desktop PC Shipments by CPU Type



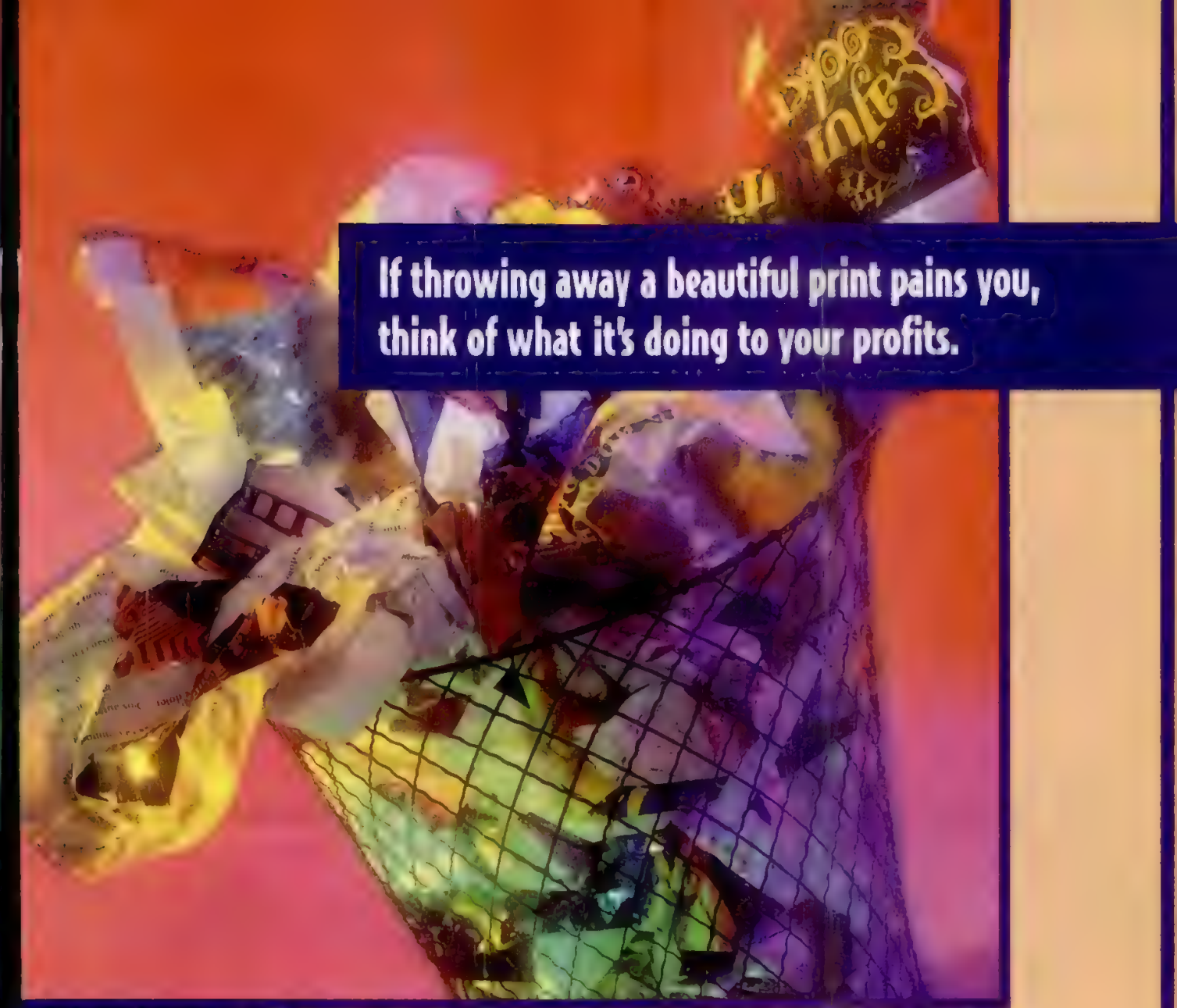
Total number of units shipped in 1993: 11.8 million.



Total number of units shipped in 1994: 12.3 million.

Source: CI InfoCorp

Our Contributors: BILL HOWARD is an executive editor at *PC Magazine*. CHRISTOPHER BARR is a former senior editor at *PC Magazine*. CAROL A. VENEZIA and ANUSH YEGYAZARIAN are staff editors at *PC Magazine*. ROBERT S. ANTHONY is a senior writer and WILLIAM P. FLANAGAN is a staff writer at *PC Magazine*. JODI L. WYNBLATT is a senior editorial researcher and MARY E. BEHR is an editorial researcher at *PC Magazine*. BRUCE BROWN is a contributing editor at *PC Magazine*. RICHARD FISCO is a project leader at PC Magazine Labs. CHARLES LIN is a technical specialist at ZD Labs. JOHN CLYMAN was the associate editor in charge of this story, and JEFFREY G. WITT was the senior project leader.



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Product Branding: *New Strategies*

By John Clyman

This fall, PC lines from some major manufacturers are undergoing significant revisions, while others are being updated with exciting new products. The most dramatic change is the IBM Personal Computer Co.'s top-to-bottom redefinition of its branding strategies for desktop PCs. Other changes include Digital Equipment Corp.'s introduction of several new product lines and Compaq Computer Corp.'s recent release of an updated version of its home-oriented Presario system. (The new Presario arrived too late for us to review it in this issue but will be covered in an upcoming roundup of consumer-oriented PCs.)

IBM's decision to revamp its lines stems from a recognition that the company's branding strategy had become overly complex and difficult for buyers to understand. Although IBM will continue producing IBM PS/2 systems through the middle of 1995, these systems will be gradually replaced by the IBM Personal Computer 700 Series of performance-oriented business desktops. Units in the IBM PC 700 Series will be Pentium PCs available with riser cards that support PCI and ISA, or the Micro Channel Architecture, which is (for all practical purposes) proprietary to IBM. IBM's ValuePoint Performance series, reviewed here, will eventually be replaced by the IBM Personal Computer 300 Series of value-oriented systems. For home users, IBM offers the Aptiva.

Digital is phasing out its entry-level, business-oriented 486 lines, the DECpc LPv and DECpc LPx series, and supplanting them with the Venturis line of value-priced PCs, which include integrated graphics accelera-

tor chips. For business users seeking higher performance levels, Digital now offers the Celebris line of DX2-, DX4-, and Pentium-based units. The Celebris PCs offer box-toppers and introductory system walk-throughs that are more typical of home-oriented PCs than traditional business computers. Digital believes that enhancing usability will pay off even for business users by reducing technical-support costs. To ease maintenance, Celebris machines are housed in cases (primarily slimline designs) that require no tools to disassemble. PCI support and 64-bit S3 graphics accelerators are standard (integrated onto Pentium units; on proprietary daughtercards in DX2 and DX4 PCs).

Digital targets the small- and home-office markets with its Starion line. Starion units are multimedia- and communication-centric machines, each of which comes equipped with a fax modem, Intel ProShare whiteboard conferencing software, and Lotus ScreenCam. The company will retain its DECpc XL line—which is upgradable to Alpha processors—for extremely performance-oriented users.

Compaq's newest Presario PCs improve on the ease of use that made them so wildly successful in the home-oriented market. The new Presarios aren't distinguished by their processor muscle—they top out at the pedestrian 486DX2/66 level—but by their design, features, and usability. The Presarios are each housed in a single case that incorporates the system unit, monitor, and speakers. They support telephony, voice mail, and direct video input. Front-end software is designed to make the systems easy to navigate even for novices. □

hard drive is standard even on home-oriented PCs, and 1GB drives (some now retail for less than \$500) are not uncommon. PCI has taken over from VL-Bus as the high-speed bus of choice. The EISA bus is now almost exclusively the province of the file server, although PCI is likely to break through there too in 1995.

Vendors are embarrassed to sell systems with 4MB of RAM this year except on some home-oriented systems; 8MB is the starting point. You're more likely to get a 15-inch monitor than a 14-inch monitor with Pentium systems, and there's a sizable minority of buyers who spend \$300 to \$500 more to substitute a 17-inch monitor.

ABOUT THE REVIEWS

Given the rapid release of new models, there are some systems that arrived too late to be included in this buyers' guide. You will find reviews for a few of these PCs in the First Looks section. The new Spectria systems from Packard Bell started shipping too late for us to include them in this roundup. Other vendors, such as Advanced Logic Research and ARES Microdevelopment, simply declined to submit systems from their product lines.

As is our practice with all PC and hardware reviews, we have arranged these 66 reviews alphabetically by vendor name, ranging from Acer America Corp. to ZEOS International. We provide a separate review for each product line a vendor submitted. The reviews are based on hands-on benchmark testing of the two or three systems that constitute a given line. All systems were tested by ZD Labs, in Foster City, California.

We include Service & Reliability ratings for all major vendors (those who received at least 50 responses in our most recent poll of 17,000 subscribers). The vendors are rated on owner satisfaction with reliability, repair service, and technical support. Note that for AT&T Global Information Solutions, we list the scores for both AT&T and NCR—although AT&T absorbed NCR, we believe the NCR crew is still running the PCs group.

Each review also includes an "In Short" statement that briefly summarizes our impressions of that product line.

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CIRCLE 090 ON READER SERVICE CARD



Benchmark Tests: Pentium and 486 PCs

It shouldn't be a surprise: Pentium/90 systems outperform the rest, providing almost twice the power of 486DX2/66s on our Winstone 95 tests. We also found that IDE drives sped past SCSI models, and machines equipped with Intel's Neptune chip set outran those using OPTi's chip set. The Diamond Stealth 64 was the best-performing graphics accelerator in these machines.

What the Numbers Mean

We report test results for the PCs in this roundup in three distinct tiers, defined by processor type: high-end Pentium/90 systems; midrange Pentium/60, Pentium/66, or DX4/100 systems; and entry-level 486DX2-class systems. Two machines based on IBM CPUs made it into our lineup—one a midrange system using the Blue Lightning 25/75, the other an entry-level machine using a 486SLC2/66. At each level, all systems were equipped with an identical amount of RAM (8MB for entry-level, 16MB for the others) and roughly equivalent hard disk capacity. We believe this stratification is representative of systems selling today, rather than that of the installed base.

The Winstone 95 benchmark tests, which measure overall performance of systems running 13 typical business-oriented Microsoft Windows applications, demonstrated a clear advantage for Pentium/90 systems. High-end machines turned in scores that were, on the average, 10 to 15 percent better than those of midrange units and fully double those of entry-level systems.

For the first time, we also print breakouts of scores for the four categories of applications that are tested in Winstone 95. The categories (business graphics/desktop publishing, spreadsheet, database, and word processing) will help determine what level of performance a system can obtain if you run similar applications within the specified categories.

The top Winstone performers combined Enhanced IDE hard disks, Windows for Workgroups 3.11, 64-bit

graphics accelerators, and well-tuned L2 cache and memory subsystems. The ZEOS Pantera Pentium-90 was the top performer overall; the other two ZEOS systems—the ZEOS Pantera Pentium-66 and the ZEOS Pantera 486DX2-66—were also leaders in the midrange and entry-level tiers.

GRAPHICS WINMARK 95 AND DISK WINMARK 95

Performance of the disk subsystem is a critical determinant of Winstone 95 performance. We measure the speed of the disk subsystem under Windows using our Disk WinMark 95 tests. Across all tiers, Enhanced IDE hard disks outscored SCSI hard disks on Disk WinMark. Enhanced IDE hard disks, when properly implemented, support an 11.1 megabyte-per-second data-transfer rate and 32-bit-wide data transfers between the disk device driver and the IDE interface.

Disk WinMark 95 results also demonstrate that the 32-bit file cache in Windows for Workgroups outperforms the 16-bit SmartDrive disk cache provided with Windows 3.1 and MS-DOS, Version 6.2. On the average, systems with Windows for Workgroups scored 62 percent higher than those without.

The Diamond Stealth 64—powered by an S3 Vision 964 chip—was the graphics card that consistently appeared in the highest-performing systems on our Graphics WinMark 95 tests. Cards based on the ATI Mach 64 were a close second. Though systems using the Matrox MGA chip scored well, there were only two systems

equipped with Matrox cards in this roundup—so it's difficult to generalize.

Note that Graphics WinMark 95 scores are substantially lower than scores generated by last year's Graphics WinMark tests. Because the tests and the weightings used to compute the results have changed, the numbers generated by the two tests are not in any way comparable.

CPUMARK₁₆

In this issue we introduce the CPUmark₁₆, which measures performance of a system's processor and memory subsystem. In previous versions of our tests, this result was known as the Processor score; however, numbers from earlier versions of PC Bench are not comparable with CPUmark₁₆ scores.

Pentium/90 systems more than doubled the CPUmark₁₆ scores of entry-level units and bettered the midrange units by more than 25 percent. The top processor scores were turned in by machines with synchronous secondary cache, which allows for a faster burst transfer mode.

The midrange units proved to be the most interesting. With four different processors battling in this tier, analysis of these numbers revealed some surprises. Pentium/66 systems outperformed Pentium/60 systems by a margin of just a few percent—nothing we think you'd actually be able to notice in everyday usage. And although the DX4/100-based machines turned in CPUmark₁₆ scores that averaged 25 percent less than those of Pentium/60 systems, the two groups were in a dead heat on the Winstone tests. This is a testament to the fact that a fast processor alone isn't enough to guarantee top-flight performance; it must be coupled to fast, well-tuned components.

One particular component that we find affects system performance is the core-logic chip set. Again in this roundup, we found that systems based on Intel's chip sets consistently outperformed those based on OPTi's competing offering.

The impact of memory-subsystem

design on system performance becomes clearly evident at the low end of the performance spectrum. The lowest processor score of any system we tested was turned in by the Epson Endeavor VL DX2/66—the only system that had no secondary processor cache. Machines with only 128K of secondary cache were also at a significant disadvantage.

DOS PERFORMANCE TESTS

Throughout this feature, we de-emphasize results of DOS benchmark tests. Partly that's because we think most buyers of new machines plan to use Windows; partly it's because we think just about any machine today is fast enough to handle most DOS applications.

The DOSmark scores we report provide a composite measure of DOS performance. In general, the faster the processor, the better its DOS performance. DOSmark scores turned in by Pentium/90s were almost 60 percent better, on the average, than the average DX2/66 score and almost 30 percent better than the midrange unit average. DOS Disk scores also varied by processor but was affected by other factors such as disk cache size, bus interface, and operating system.

CD-ROM PERFORMANCE TESTS

For the first time in a PC review, we tested CD-ROM drives using Microsoft VidTest and the Windows version of Ziff-Davis's Computer Select CD-ROM database. The fastest (and most expensive) quadruple-speed drives were found in the high-end units, while the entry-level units used exclusively double-speed drives.

In most cases, throughput measurements matched the drives' specified transfer rates. But results on our database search varied widely, partly because of the effects of disk caching. Data is read from the CD-ROM sequentially, with occasional repeated reads; if SmartDrive is installed properly, these repeated reads will be rapidly retrieved from cache.

Since MS-DOS, Version 6.2, Smart-

Drive has had the ability to cache CD-ROM drives—as long as MSCDEX, the CD-ROM driver, is loaded ahead of SmartDrive. Although many vendors failed in this setup and we tested the units as configured, you can easily correct these problems yourself.

—Analysis written by Richard Fisco

How We Tested

For all tests, we enabled the latest version of SMARTDRV.EXE provided on the tested system; we also used a cache size of 2MB (on 8MB systems) or 4MB (on 16MB systems), with write-behind caching enabled. For systems running Microsoft Windows for Workgroups, we set up a file cache of 2MB (on 8MB systems) or 4MB (on 16MB systems). We directed Windows to use a 20MB permanent swap file but did not change the vendor's setting for 32-bit disk access.

We used the custom graphics drivers for provided graphics adapters and set resolution to 800 by 600 with 256 colors and small fonts. Each monitor's vertical refresh rate was set to 72 Hz. Power management features were disabled, and unnecessary drivers (such as sound card drivers) were temporarily removed.

We used our new **Winstone 95**, Version 1.0, benchmark tests to measure the machines' performance when running typical Windows applications. Winstone 95 measures the time a PC takes to execute a set of application scripts that exercise 13 of the best-selling Windows 3.x applications. Winstone weights the individual script execution times using the unit market shares of the applications and normalizes scores against a reference machine—a 386DX/25 Compaq Deskpro/M with 4MB of RAM—whose score is defined to be 10. Winstone also produces system performance scores for four categories of applications: word processing, spreadsheet, database, and business graphics/desktop publishing.

Another test suite, WinBench 95, uses 102 different tests of Windows GDI (Graphics Device Interface) functions to produce the **Graphics WinMark 95**—a measure of PC graphics performance under Windows 3.x. These graphics tests, which are based on extensive application profiling, run in 13 graphics test mixes that WinBench weights and combines to produce the Graphics WinMark. Scores are reported in millions of pixels per second.

WinBench 95 also produces a **Disk WinMark 95** score, which reflects the performance of a PC's disk subsystem under Windows 3.x. The test suite uses a variety of files and directories in a blend

based on profiling of applications' disk usage in Winstone.

PC Bench 9.0 predicts processor, video, and disk performance under DOS applications. A composite PC Bench score, the **DOSmark**, is a summary of those three results that approximates overall system performance under DOS.

PC Bench's **CPUmark₁₆** score, which replaces the Processor score, gauges the speed of a PC's processor subsystem, including the CPU, secondary cache, and system RAM. PC Bench bases this score on a large (400K) instruction mix and either the floating-point coprocessor test or the floating-point emulation test, depending on whether the tested PC contains a math coprocessor.

The PC Bench **DOS Video** score indicates the speed of 8- and 16-bit VGA read and write operations involving both text and graphics.

The PC Bench **DOS Disk** score gauges the DOS performance of a PC's disk subsystem, which includes the hard disk, disk controller, and any hardware or software disk caches. The Disk Mix test that produces this score works with hundreds of files in over 100 directories totaling over 28MB in size. The test performs file reads, writes, creations, and deletions in a mix based on the disk usage of a set of profiled applications.

For gauging the quality of multimedia playback, Microsoft Corp. granted us permission to use VidTest—a Windows-based, digital-video performance-test program that has become the de facto standard for measuring performance of multimedia PCs. We use VidTest's Data Streaming test to determine **CD-ROM Maximum Throughput**, a measure of the drive's best-case data-transfer rate in kilobytes per second. The Data Streaming test also measures **CD-ROM CPU Utilization**, which indicates the percentage of the processor's bandwidth occupied by servicing the CD-ROM subsystem at a 300-Kbps transfer rate. (For this test, lower numbers indicate better results.)

We also tested performance of the CD-ROM subsystems accessing the August 1994 Windows version of Ziff-Davis's Computer Select CD-ROM database, which contains thousands of full-text articles from hundreds of computer-industry periodicals. Searching Computer Select primarily involves sequential-read operations, as large word indexes are scanned. The **CD-ROM Database Search** numbers indicate the time required for the machine to find all 51,460 articles containing a match for the Boolean expression "the AND (is a) OR at". For this test, lower numbers (shorter times) indicate better results.

What the Numbers Mean

Well-tuned processor/memory subsystems, 64-bit VRAM-based graphics cards, and Enhanced IDE disk drives are the common components used by the top-scoring Pentium/90 machines on our Winstone 95 tests. Top Winstone honors went to the ZEOS Pantera Pentium-90, which was followed by the ZDS Z-Station EX and the Sidus Formula SCI9P590PDT. By contrast, the worst performers used SCSI hard disks and DRAM-based graphics accelerators.

The graphics-performance champions use Diamond Stealth 64 VRAM cards, which employ a 64-bit S3 Vision 964 chip and dual-ported VRAM. The top eight systems on our Graphics WinMark 95 tests use Stealth 64 VRAM cards. They were followed closely by machines equipped with Stealth 64 DRAM and ATI Graphics Pro Turbo cards. Using single-ported DRAM or a 32-bit accelerator chip helped ensure a score near the bottom of the pack.

The strength of Enhanced IDE hard disks is unparalleled under Windows. The top 16 scores on our Disk WinMark 95 tests went to PCs equipped with Enhanced IDE disk subsystems and Microsoft Windows for Workgroups, which supports 32-bit file caching.

The best CPUmark₁₆ scores went to systems with Intel's Neptune chip sets. Their scores were aided in some cases by fast, expensive synchronous SRAM for their L2 processor caches. The top scorers were the HP Vectra XU 5/90C, the AST Premmia GX P/90, and the Dell OmniPlex 590. (The tested HP system came with 512K of L2 cache, a nonstandard configuration that must be special-ordered from the company.) PCs using OPTi PTM3V chip sets were hurt on our tests by extra delays and synchronization overhead in PCI-bus transfers.

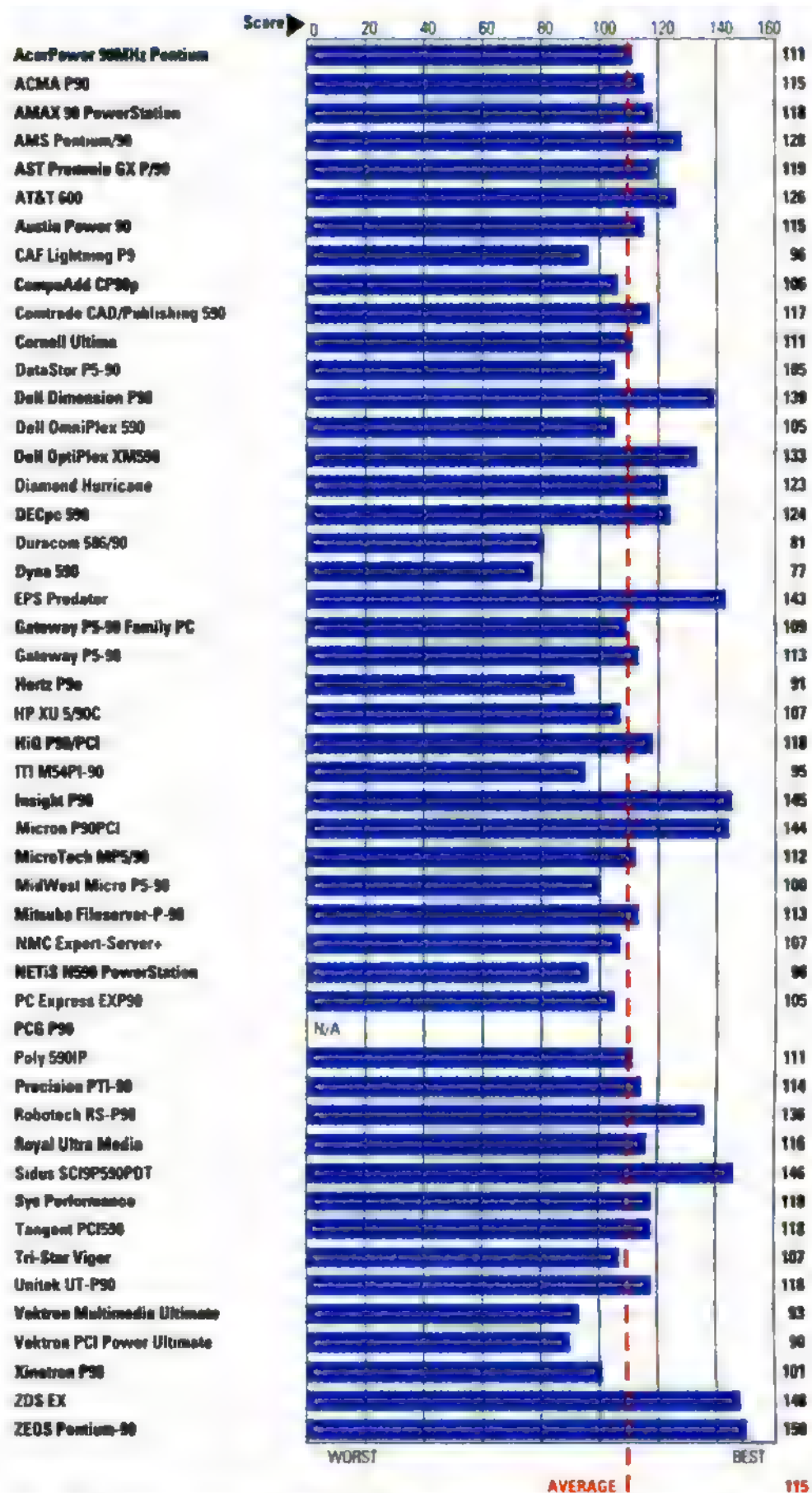
The top DOSmark performers were the Mitsuba Fileserv-P-90 and Tangent PC1590, but at this level, even the slowest machine will be sufficiently fast for most DOS users.

On our CD-ROM tests, systems with quadruple-speed CD-ROMs generally outperformed those with slower models, but often by only a small margin.

For a detailed discussion of how we tested the systems, see the introduction to the benchmark test section.

—Analysis written by Richard Fisco

WINSTONE 95



N/A —Not applicable. The PCG P90's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

Overview: High-End Systems

By John Clyman

Admit it: The system you *really* want is based on a Pentium/90. And why not? Machines built around the fastest Intel processor in widespread production are, at their best, three times the speed of a typical entry-level 486DX2/66, according to our Winstone 95 test results. Yet they're nowhere near three times the price.

For example, take the Gateway 2000 P5-90 XL, the lowest-priced of the 49 Pentium/90 systems in our roundup. For

\$2,779 (about \$1,000 more than the average entry-level system in our roundup), you get 16MB of RAM, a 731MB hard disk, a double-speed CD-ROM drive, and a 15-inch monitor. And you can find stripped Pentium/90s for less than \$2,500.

A more typical Pentium/90 machine costs \$4,000. From many system vendors, that sum will buy a 1GB hard disk and a 17-inch monitor. Those are the kinds of components you should be considering with systems of this caliber; it's foolish to

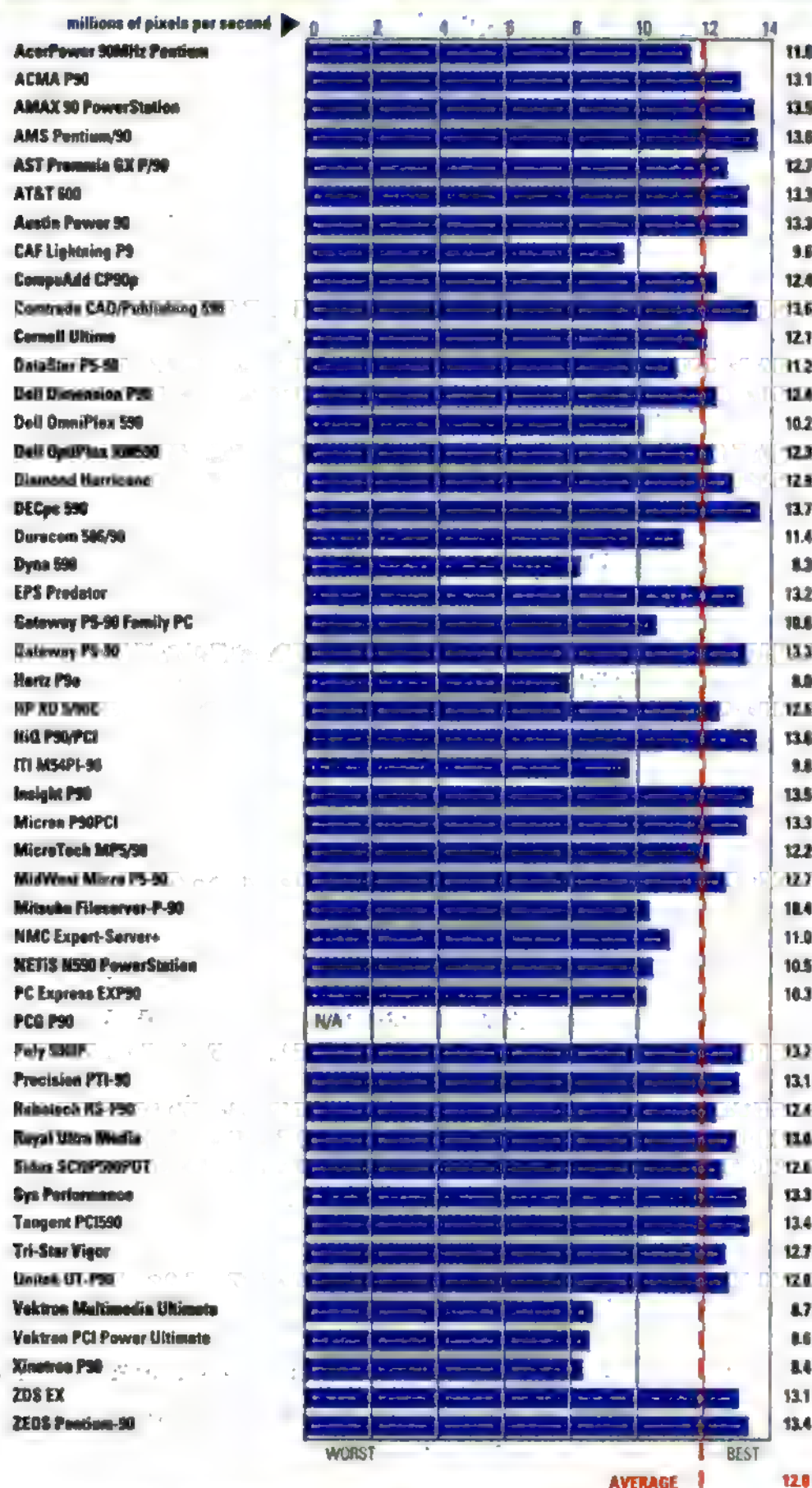
spurge on the processor only to skimp on the graphics card or hard disk.

In fact, component quality is a crucial differentiator among high-end systems today. To keep a 90-MHz Pentium processor running at peak capacity, you've got to be able to feed it data quickly. Notice that the fastest Pentium/90 system we tested nearly doubled the Winstone score of the slowest (which was barely faster than the best 486DX2/66 performers).

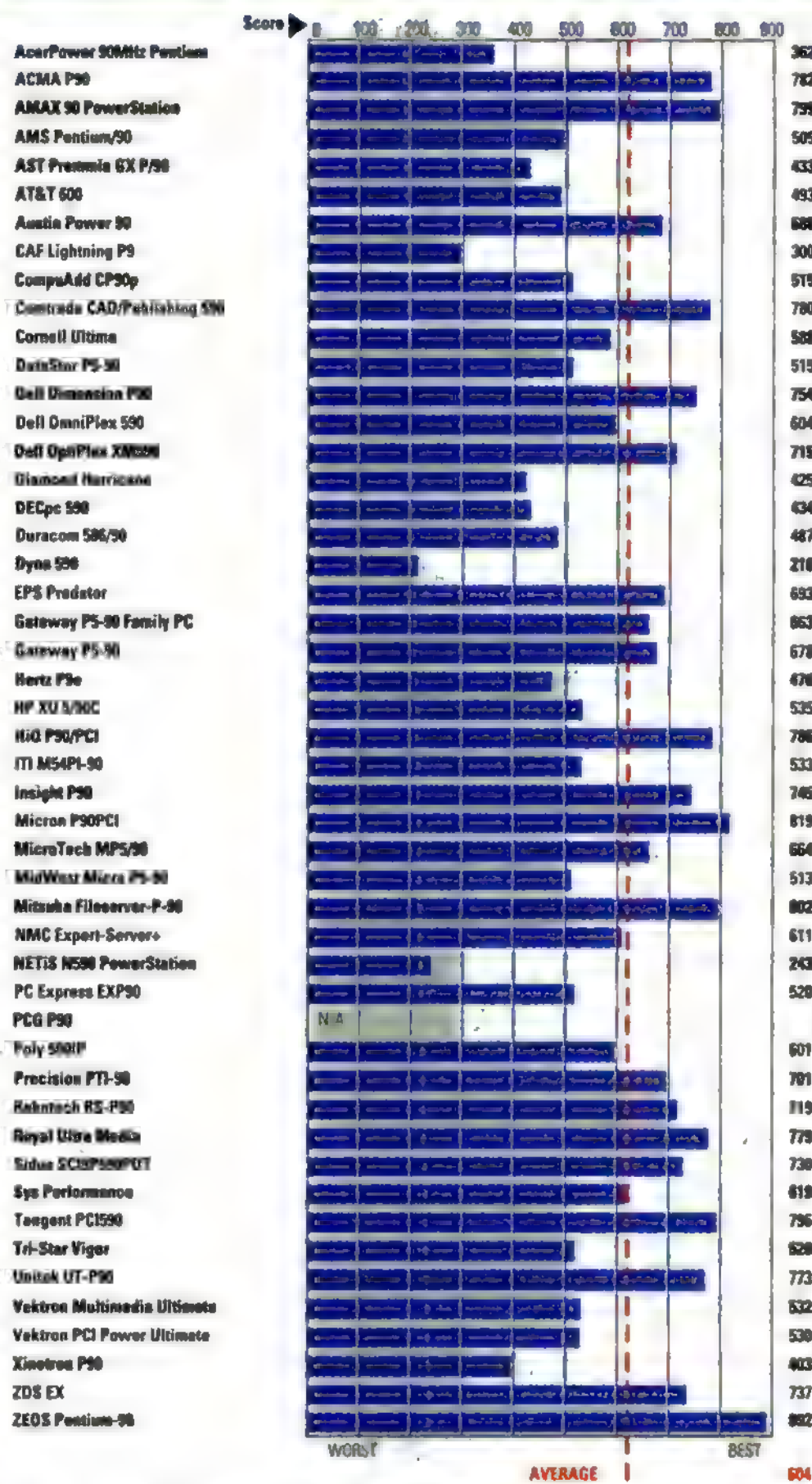
Who needs this level of performance? Anyone who can afford it. Thanks to Intel's increasingly aggressive pricing, the

GRAPHICS WINMARK 95

DISK WINMARK 95



N/A —Not applicable. The PCG P90's processor was being run faster than its rated speed, so we consider the unit's test results invalid.



N/A —Not applicable. The PCG P90's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

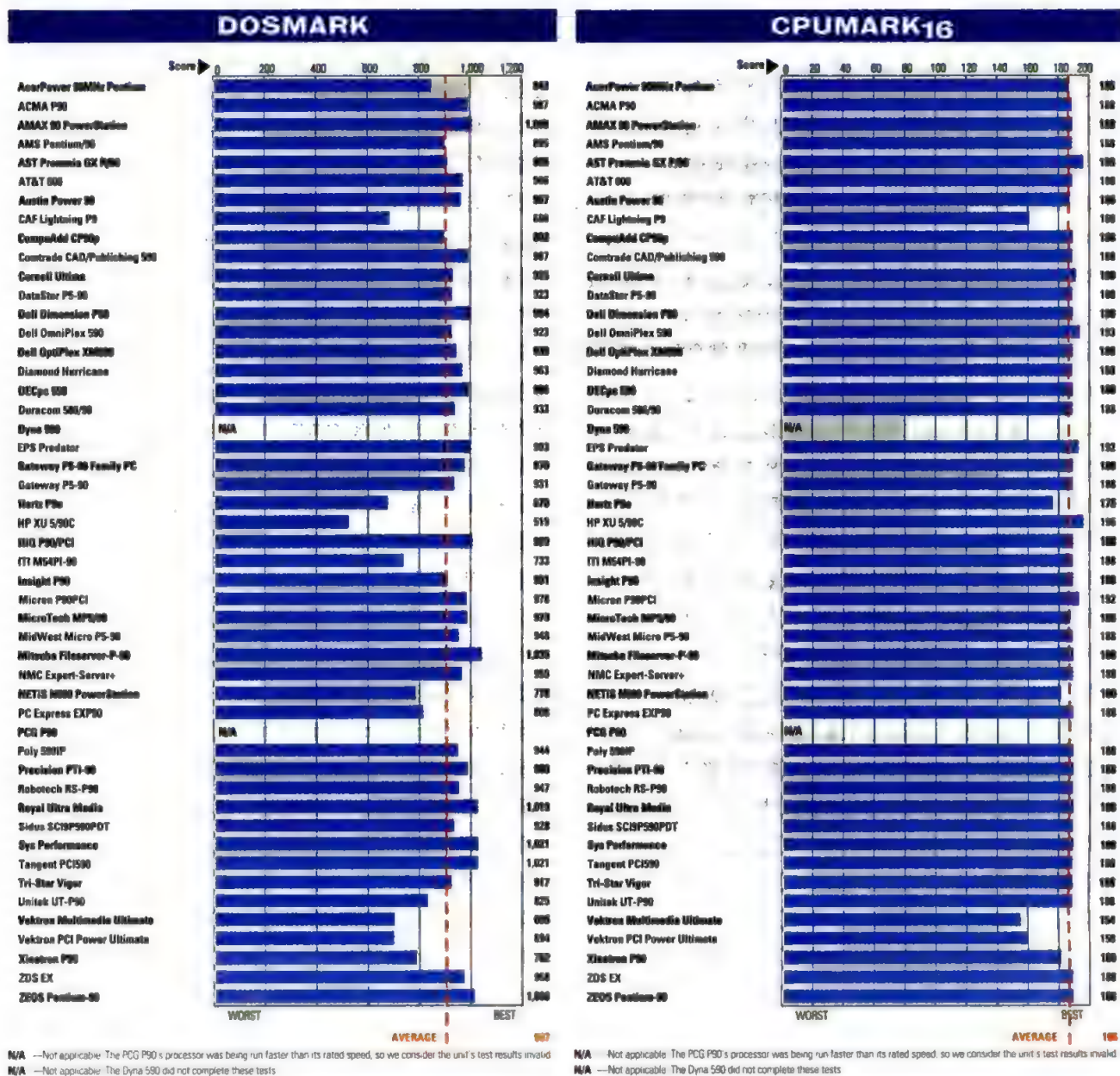
Pentium is poised to overtake the 486 and become the mainstream CPU of choice. And performance aside, the Pentium/90 offers compelling advantages over its 60- and 66-MHz siblings. For one thing, it's manufactured using a newer 3.3-volt technology, so it draws less power and runs cooler. (It's even possible to build Energy Star-compliant 90-MHz Pentium machines, something that's extraordinarily difficult with the 5-volt 60- and 66-MHz chips.) Another advantage is that the Pentium/90 CPU is priced at only about \$300 more than a Pentium/60 processor; that means that the price dif-

ference between identically configured 60- and 90-MHz machines is only about 10 percent.

Unless you're committed to maximizing system performance at any price, don't hold out for the 100-MHz Pentium. Its introduction has already been delayed several times—and when it does arrive, you will probably find that the performance it delivers is not worth the added price. Our tests of a preproduction 100-MHz Pentium system from Micron Computers found it to be about 6 percent faster than an equivalent 90-MHz machine on our Winstone tests.

OF CHIP SETS AND HARD DISKS

Our testing helped us identify two factors that are crucial to achieving peak performance in 90-MHz machines. One is the core logic chip set that the processor uses to communicate with system memory and expansion buses. Intel's Neptune chip set, used by more than three-quarters of the machines we tested, contributed to consistently better performance scores than the OPTi chip set found in the others. The presence of both VL-Bus and PCI expansion slots is a dead giveaway that there's an OPTi chip set inside a system, since Neptune supports only PCI.



The second factor is the system's hard disk interface. Although SCSI's proponents argue that the advent of 32-bit operating systems with true multitasking support will better leverage SCSI's capabilities, IDE is the clear performance leader under today's Windows. IDE's strength is largely due to now-common support for the Enhanced IDE and Fast ATA standards, which provide for a burst-transfer mode of 11.1 megabytes per second, slightly faster than SCSI's 10.0 MBps. Enhanced IDE also obviates the 528MB capacity barrier for IDE drives under DOS. Half of the high-end systems

in this roundup were equipped with IDE, not SCSI, hard disks.

INSIDE THE MACHINES

Each of the Pentium/90 systems in this roundup supports PCI; although six also provide VESA local bus slots, it's clear that the VL-Bus has been mostly relegated to 486-class machines.

In almost every system, one of the PCI slots was occupied by a graphics accelerator card. Only three high-end machines—the Dell OmniPlex 590, the Dell OptiPlex XM590, and the ZDS Z-Station EX—employed graphics accelerators integrated

onto the motherboard. The Dell OmniPlex 590 turned in a Graphics WinMark 95 score that was well below average, but the other two machines' graphics subsystems were competitive.

Although many of the high-end machines were shipped in hulking tower cases, not all provided quite the expansion room we expected. In many machines, parallel and serial I/O and disk controllers were located on expansion cards, occupying one or more slots. And we were dismayed to find that many vendors neglected to use the cutouts provided on the back of the system chassis to



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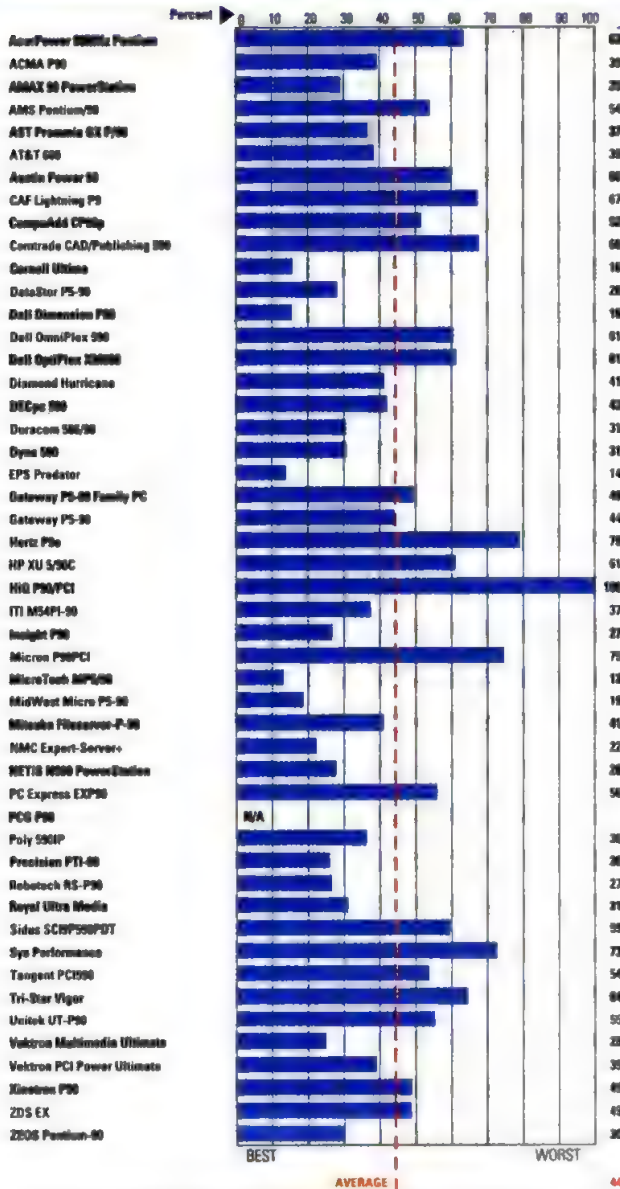
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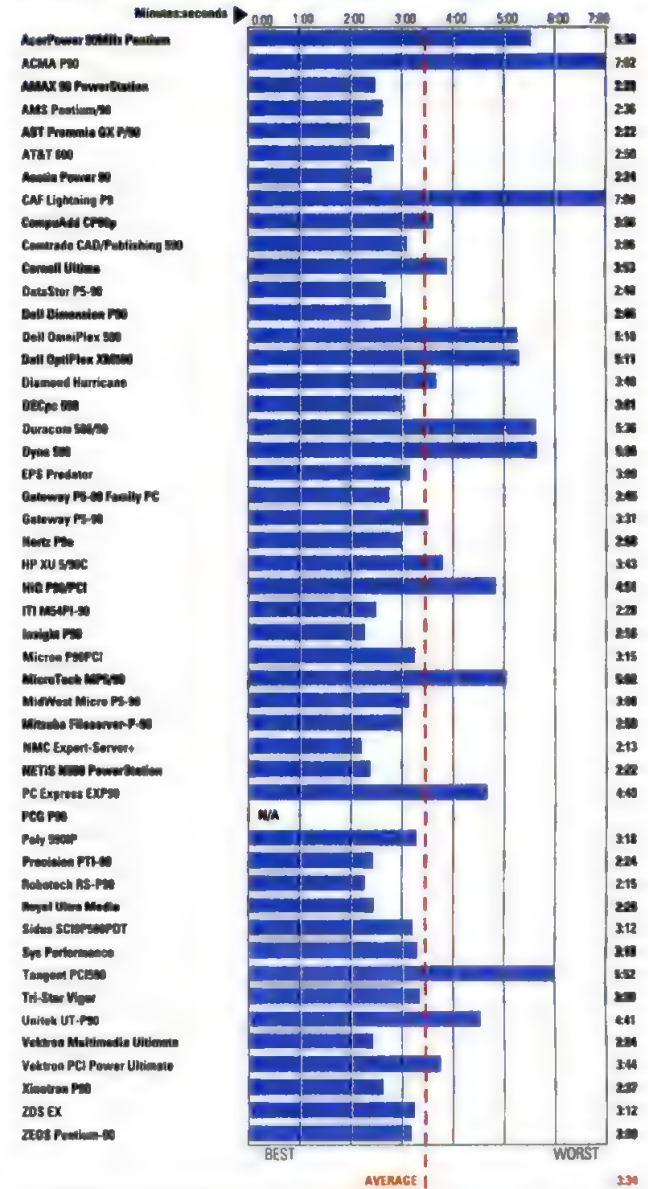
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CD-ROM CPU UTILIZATION



N/A —Not applicable. The PCG P90's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

CD-ROM DATABASE SEARCH



N/A —Not applicable. The PCG P90's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

route the parallel and serial connectors; instead, they put them through the back-plate of a slot. Although this is easy enough to correct when you need to insert a card, we think it shows a lack of care in machine assembly.

We were pleased to see that a number of the Pentium/90 systems were equipped with quadruple-speed CD-ROM drives, which we expect to become much more

common on high-end systems over the next year. A couple also had built-in PCMCIA slots to ease data exchange with notebook computers.

QUALIFYING QUALITY

In many instances, it's the intangibles that make some of these high-end systems stand out from the pack. An example of superior design is the \$5,525 HP Vectra

XU 5/90C, a past Editors' Choice selection that did not live up to our performance expectations this time around, in part because it used a comparatively slow SCSI hard disk. But the attention to detail in this system's design remains enviable: All of its internal components are easily accessible, thanks to a power supply that swivels out of the way. The front-panel lights and buttons can be rotated to

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	DOS Video (Score)	DOS Disk (Score)	Windows 95 Database Category (Score)	Windows 95 Spreadsheet Category (Score)	Windows 95 Business Graphics/ Desktop Publishing Category (Score)	Windows 95 Word Processing Category (Score)	CD-ROM Maximum Throughput (Kbytes/sec)
AcePower 90MHz Pentium	2,731	603	10.4	11.5	12.1	10.7	301
ALUMA P90	4,111	611	11.1	11.1	12.9	10.2	411
AMAX 90 PowerStation	4,792	717	11.7	13.2	12.4	10.5	451
AMS Pentium/90	4,111	611	11.1	11.1	12.9	10.2	411
AST Premium GX P/90	2,743	689	11.5	12.0	13.0	11.3	330
AT&T 600	1,111	611	11.1	11.1	12.9	10.2	411
Austin Power 90	4,785	659	11.6	12.9	11.9	10.3	601
CAF Lightning P9	2,275	411	11.1	11.1	12.9	10.2	411
CompuAdd CFS90p	6,142	528	10.7	11.4	11.0	9.7	301
Comtrade CAD Publishing 590	4,784	687	11.7	12.9	12.2	10.5	301
Cornell Ultima	4,546	804	11.1	11.9	11.1	10.3	601
DataStar PS 90	5,131	586	11.1	11.3	10.5	9.7	330
Del Dimension P90	5,553	678	12.9	14.1	15.6	12.8	300
Dell OmniPlex 590	3,312	665	11.1	11.1	10.7	9.8	369
Dell OptiPlex XM590	4,852	619	13.3	13.7	15.5	11.9	300
Diamond Hurricane	4,783	660	11.1	12.4	13.7	11.7	295
DECpc 590	5,637	684	11.7	12.8	13.7	11.8	300
IBM 586-90	5,692	588	8	8.3	8.5	7.4	335
Dyna 590	N/A ¹	N/A ²	7.7	8.1	8.3	7.1	335
EPS Predator	4,772	696	11.1	14.7	16.5	13.2	301
Gateway PS-90 Family PC	5,136	654	11.0	12.0	11.5	9.8	301
Gateway P/90	5,136	654	11.0	12.5	11.7	10.1	301
Hertz P90	1,492	532	9.3	9.9	9.2	8.3	365
HP XU 5/90C	655	599	10.9	11.1	11.1	10.1	301
HQ P90/PCI	4,778	716	11.8	12.9	12.5	10.6	150
TruM54P-90	1,671	511	10.1	9.3	8.8	8.8	451
Imight P90	4,778	590	14.2	15.0	16.2	13.3	801
Micro P90/PCI	4,571	681	11.1	15.0	16.1	13.2	301
MicroTech MPS/90	4,083	728	11.0	12.1	12.0	10.1	242
MidWest Micro PS-90	6,295	585	9.4	10.9	9.9	9.7	301
Mitsuba Fileserver-P/90	5,135	763	11.2	11.9	12.7	10.0	300
NMC Expert Server+	4,455	668	10.8	11.3	11.5	9.8	601
NETIS N590 PowerStation	2,040	802	9.4	10.2	10.1	8.6	451
PC Express EXP90	2,234	601	11.1	11.1	11.1	10.1	301
PC9 P90	N/A ¹	N/A ¹	N/A ¹	N/A ¹	N/A ¹	N/A ¹	N/A ¹
Poly 590IP	5,193	617	11.1	11.9	11.4	10.2	335
Precision P/90	4,185	715	11.4	12.2	12.1	10.2	449
Robotech RS P90	4,160	662	13.1	13.9	15.9	12.1	601
Royal Ultra Media	5,075	737	11.5	12.5	12.5	10.3	451
Sus SC9PS590POT	4,122	634	14.1	15.2	16.2	13.5	301
Sys Performance	4,180	784	11.7	12.7	13.1	10.4	301
Tangent PC590	5,627	717	11.1	12.8	12.6	10.6	301
TruStar Vigor	4,187	615	10.8	11.7	10.6	9.9	301
Unitek UT P90	5,195	469	11.6	11.6	11.4	10.1	301
Vektron Multimedia Ultimate	1,912	542	9.0	10.2	9.6	8.7	601
Vektron PCI Power Ultimate	1,902	532	8.8	9.9	9.5	8.3	300
Xenatron P90	2,042	611	9.8	9.9	12.4	9.1	331
ZDS EX	4,186	687	14.4	15.4	16.6	13.5	301
ZEOS Pentium-90	4,576	742	14.5	15.4	17.3	13.7	301
Alpha 90	4,114	611	11.1	12.2	12.4	10.5	357

N/A¹ Not applicable. The PC9500 processor was being run faster than its rated speed, so we have the 100MHz rating in parentheses.

N/A² Not applicable. The 586-90 processor was being run faster than its rated speed, so we have the 100MHz rating in parentheses.

accommodate either a desktop or a mini-tower orientation. And in general, the HP XU 5/90C provides a sense of overall fit and finish that we wish were more common.

We've also been impressed in the past with the design of Compaq systems, but Compaq had not yet released a Pentium/90 desktop model when we completed this story.

On the other hand, we were slightly disappointed to see that the \$3,195 ZEOS Pantera Pentium-90, the best-performing system overall, could accommodate only one full-length ISA card because of the positioning of its CPU and cache SIMM. Although relatively few users today need full-length cards, we wish that such an otherwise appealing system hadn't had such a flaw.

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Benchmark Tests: Midrange Systems

What the Numbers Mean

Results for the midrange tier of machines showed some decidedly intriguing trends. While we noticed that CPUmark₁₆ scores correlated with the processor used, Winstone 95 scores were closely grouped across all the processor types. One point of interest: The CAF Lightning P6 was sent to us with a Pentium/66 processor running at only 60 MHz. Because we were unable to run our Winstone 95 tests successfully at 66 MHz on this machine, we report results for 60 MHz.

The top Winstone scorers among these systems were Pentium/66 units: the ZEOS Pantera Pentium-66, the Austin Communications Manager P66, and the Insight PCI P66 MM. The ZEOS Pentium-66's components include a Micropolis hard disk, which helped it garner a first-place Disk WinMark 95 score, and a Diamond Stealth 64 VRAM card, which helped it earn a most respectable fifth-place score on our Graphics WinMark 95 tests.

Four systems tied to beat the ZEOS Pentium-66's Graphics WinMark score: The Austin Communications P66, the Comtrade PCI Best Buy 566, and the Micron 4100PCI Magnum (each of which uses a Diamond Stealth 64 card), and the Tri-Star Tri-CAD Pentium 66 (which utilizes an ATI Graphics Pro Turbo card).

The winners on our Disk WinMark tests took advantage of the abilities of Enhanced IDE drives and Microsoft Windows for Workgroups 3.11. The top finishers were the ZEOS Pentium-66, IBM ValuePoint 100DX4/Dp, and Comtrade PCI CAD/Publishing 566.

CPUmark₁₆ scores, with the exception of the underclocked CAF Lightning P6's score, fell in line precisely by processor type. The top scorers within each processor type each utilize more than 256K of L2 cache, fast synchronous L2 cache SRAM, and fast memory subsystems—or combinations of these attributes. Machines using OPTi chip sets were hurt because that chip set generally inserts extra wait states in burst mode. The IBM Blue Lightning 25/75 used in the Alaris Cougar EnergySmartPC 486BL3X 75 was simply outclassed by the competition in this tier.

If DOS is still your first love, the ACMA P66 Tower is your best bet among these machines. Fueled by the strong DOS graphics performance of its Diamond Stealth 64 DRAM card and its fourth-place DOS disk score, the ACMA machine had the highest DOSmark score of the midrange systems.

For a detailed discussion of how we tested the systems, see the introduction to the benchmark test section.

—Analysis written by Richard Fisco

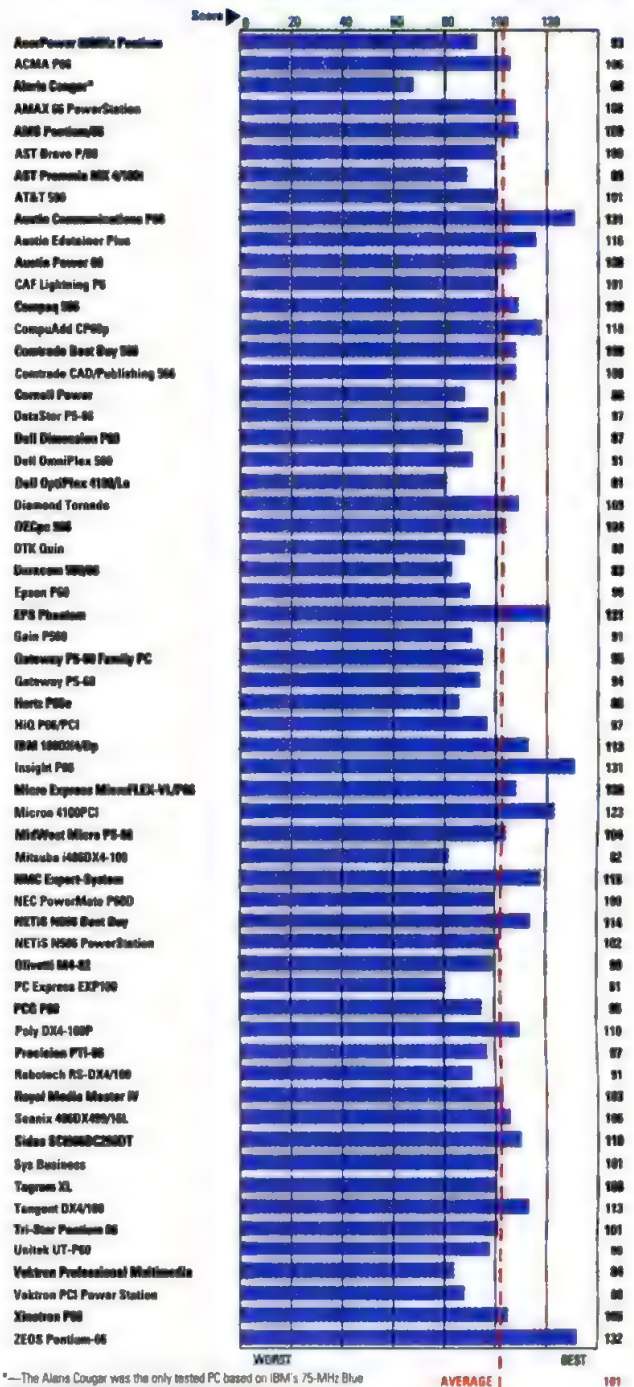
Overview: Midrange Systems

By John Clyman

If a 486 system feels underpowered, and a Pentium/90 machine seems out of reach, you've still got a number of options. Midrange PCs based on DX4/100, Pen-

tium/60, and Pentium/66 CPUs split the difference between the low and high ends in terms of price and performance. (Though we also tested a midrange machine from Alaris based on an IBM Blue

WINSTONE 95



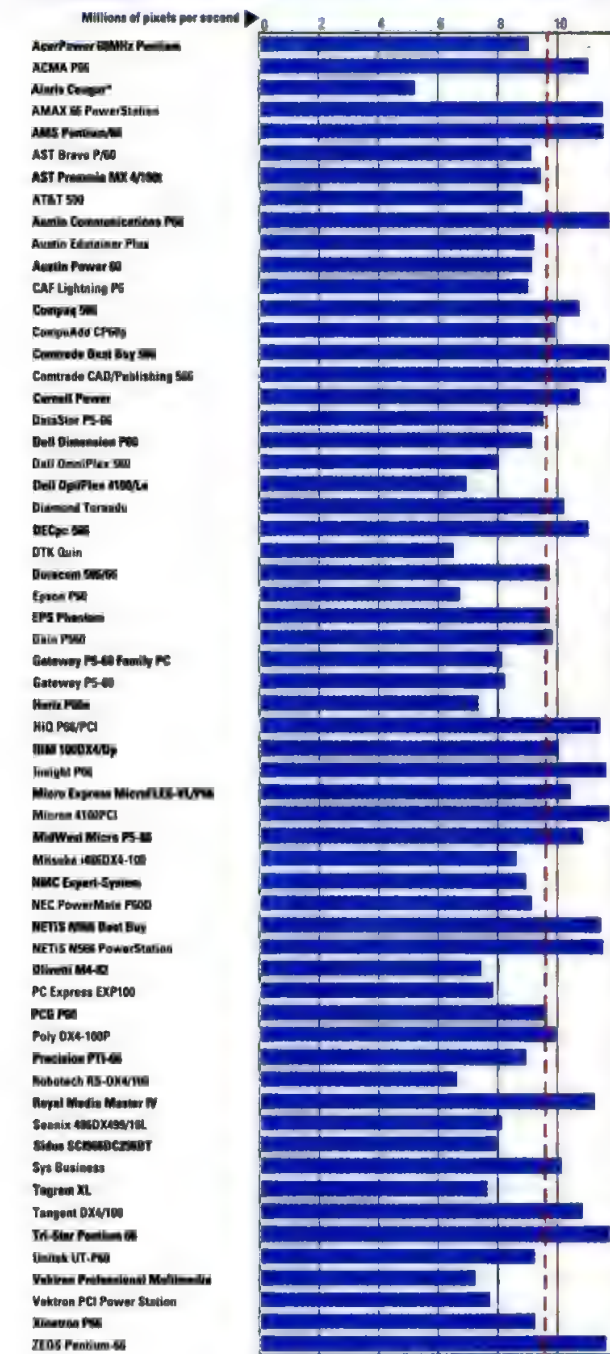
*—The Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lightning CPU; all other systems here are based on faster processors.

Lightning 25/75 CPU, we think that processor's performance is really more suited to the entry level.)

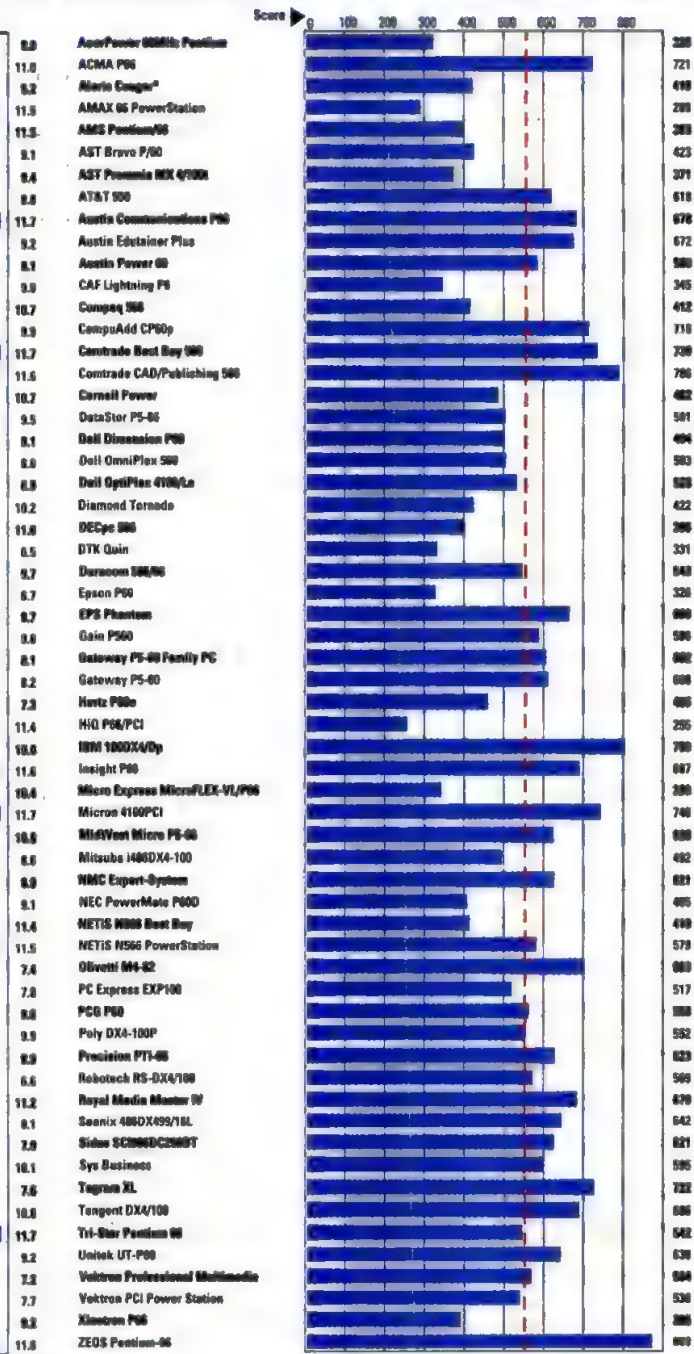
Industry pundits may proclaim that the "real" Pentium is the one that runs at 90 MHz, not 60 or 66. Yet our benchmark test results might convince you that the 60- or 66-MHz CPU is fast

GRAPHICS WINMARK 95

DISK WINMARK 95



*—The Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lightning CPU; all other systems here are based on faster processors.



*—The Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lightning CPU; all other systems here are based on faster processors.

enough for your needs. The average Winstone 95 score of our 60 midrange systems was about twice that of the 486DX2/66 systems. Part of that difference is attributable to the 16MB of memory we required in midrange machines (versus 8MB in entry-level systems). But a large part of this difference

is also the result of a faster CPU and superior memory-subsystem design. Even though DX4/100 units employ a different design than Pentium/60 and Pentium/66 units—and though they turned in CPUmark₁₆ scores that averaged 25 percent slower—it turns out that units based on any of these three CPUs post-

ed similar scores on our Winstone tests.

The average price of the 60 midrange PCs that we tested was just over \$3,100, which compares with around \$2,200 for entry-level units and about \$4,000 for high-end systems. The small difference in price among PCs in the different tiers might be reason to consider moving up a

THEY NOT ONLY
SOUND GREAT,
THEY PUT PRODUCTIVITY
IN MOTION.

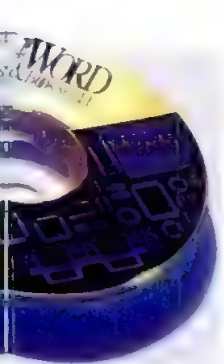
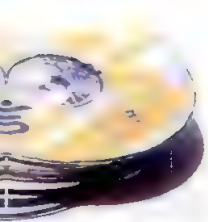


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August 1994
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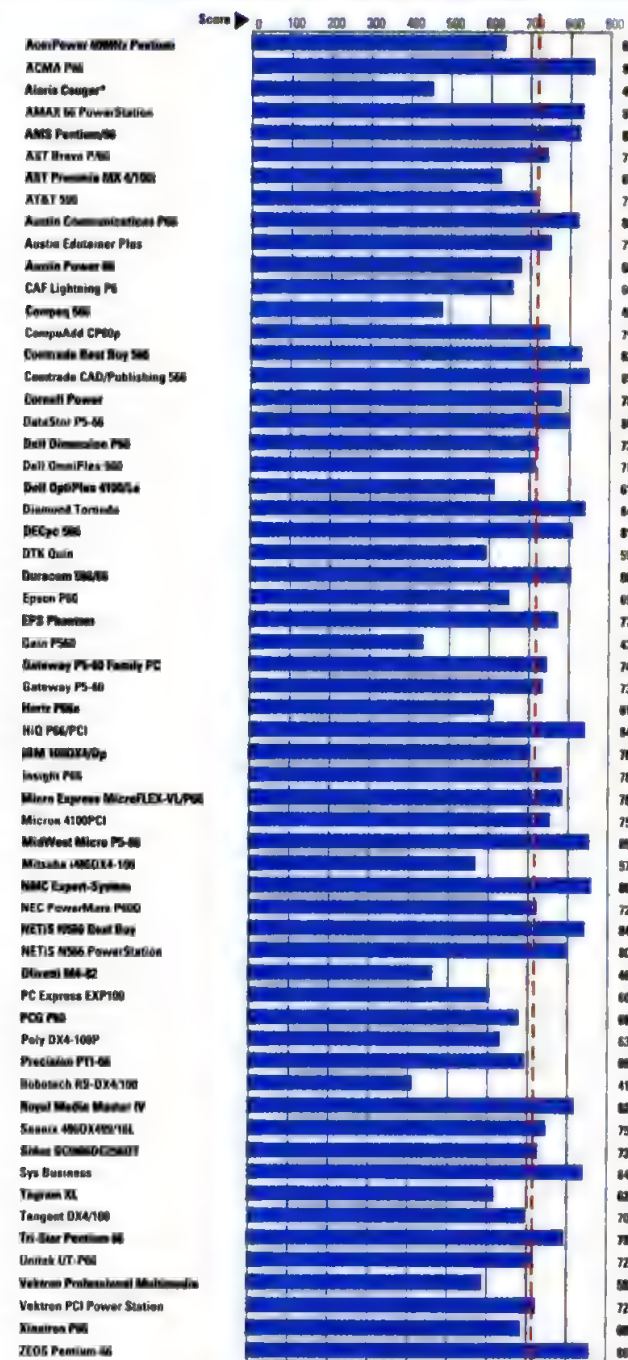


July 1994

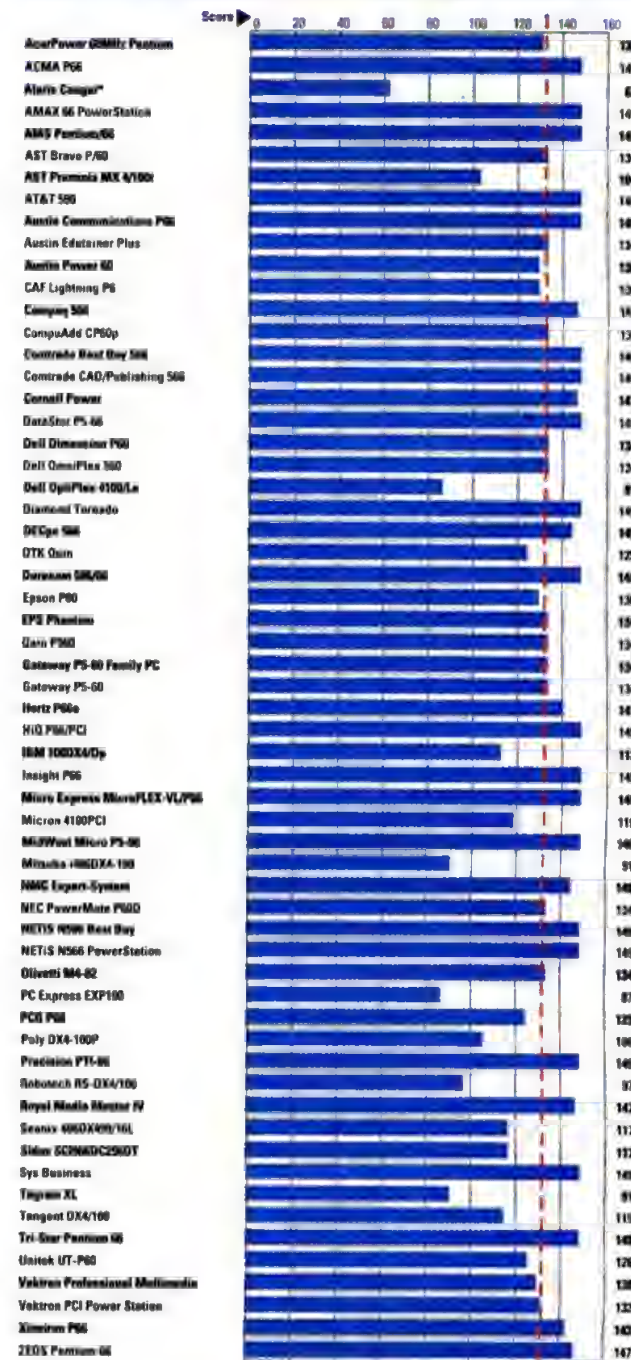
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CIRCLE 304 ON READER SERVICE CARD

DOSMARK

CPUMARK16



*—The Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lighting CPU; all other systems here are based on faster processors.



*—The Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lighting CPU; all other systems here are based on faster processors.

rung on the ladder. The Pentium/90 CPU itself costs only about \$300 more than the Pentium/60; the additional cost difference between complete Pentium/60 and Pentium/90 systems is in large part accounted for by larger hard disks, bigger monitors, and larger amounts of graphics memory in the high-end PCs.

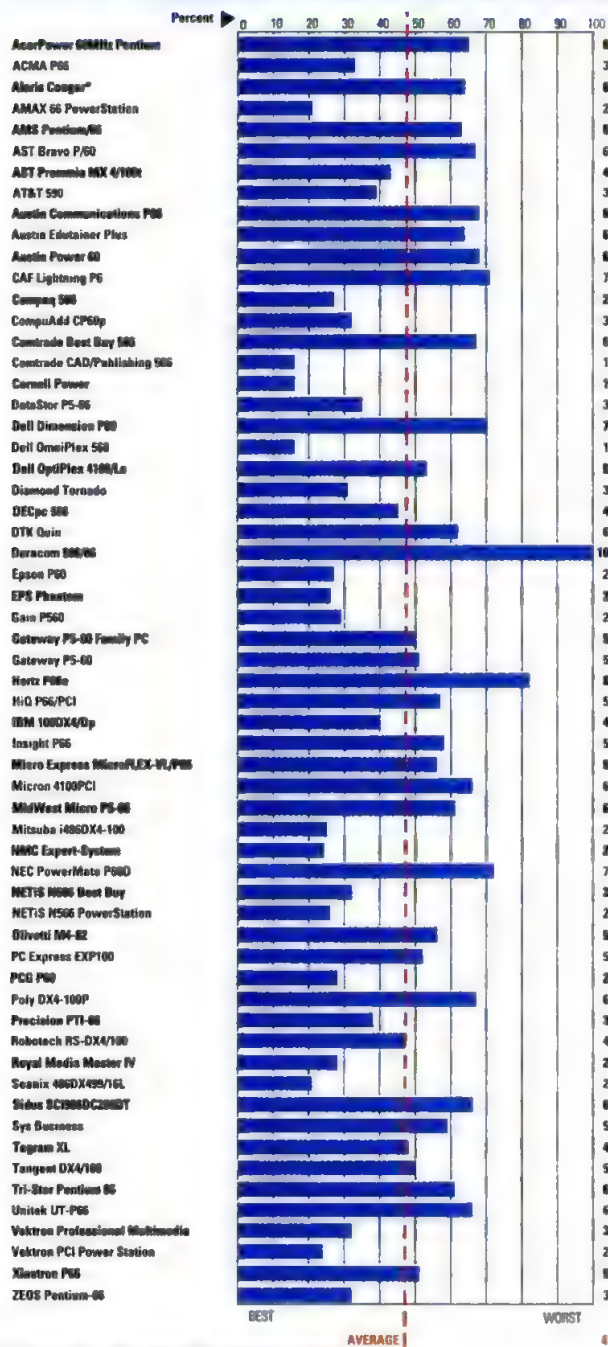
The Pentium/60 and Pentium/66 are both likely to be eclipsed by the recently announced Pentium/75. Although the Pentium/75 is targeted at the notebook market, we think it's likely to become the entry-level CPU of choice on the desktop by mid-1995. Like the 90-MHz version, the 75-MHz Pentium runs on 3.3 volts; we

think it's the ideal CPU for reasonably priced, Energy Star-compliant, home-use PCs. Pentium PC prices will continue to drop as Intel phases out the 486 family.

UNDER THE HOOD

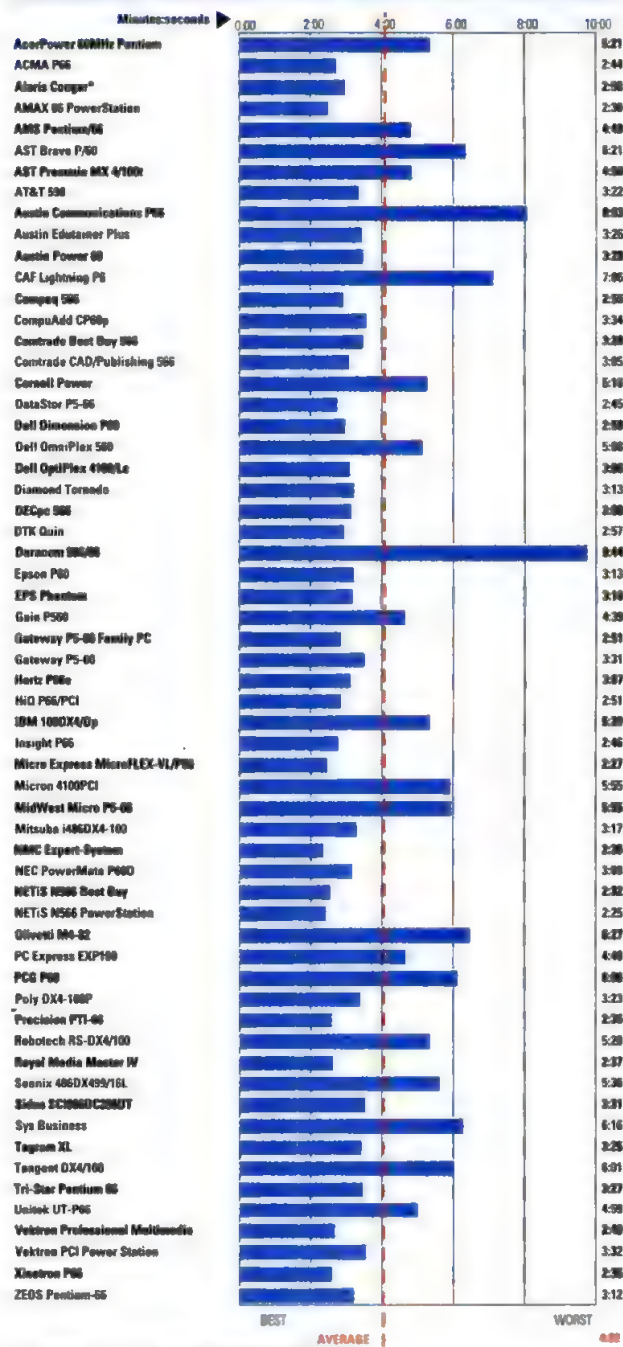
DX4/100-based systems tend to look much like entry-level systems in terms of system

CD-ROM CPU UTILIZATION



*... The Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lighting CPU; all other systems here are based on faster processors.

CD-ROM DATABASE SEARCH



*... This Alaris Cougar was the only tested PC based on IBM's 75-MHz Blue Lighting CPU; all other systems here are based on faster processors.

architecture. Among the midrange units, VL-Bus was more common than PCI, appearing in more than half the systems; a couple of systems had no high-speed expansion bus at all—a key deficiency. Of the 47 Pentium/60 and Pentium/66 PCs, only 2 (the DTK Quin-32 and the Micro Express MicroFLEX VL/P66) did not support PCI.

A few of the PCI-based machines also supported VL-Bus, but these hybrid units were lackluster performers.

WHAT TO LOOK FOR

For a Pentium or DX4 system, don't skimp on memory (we think 8MB is insufficient in this range; go for 12MB or 16MB) and

cache RAM (256K is essential). Avoid inexpensive systems with graphics cards with only 1MB of video RAM or undersize 14-inch monitors. And buy the biggest hard disk you can afford: Start with half a gigabyte. Unless you're wedded to SCSI's expandability, we think Enhanced IDE is a better choice for your hard disk interface.

EDITORS' CHOICE



Sept 27, 1994
Tri-Star Vigor PCI-90

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PC Magazine, September 1994



READERS' CHOICE



"...among the elite on service and support."

PC Magazine
July, 1994

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Benchmark Tests: Midrange Systems

CONTINUES

Higher scores represent better performance

	DOS Video	DOS Disk	Winstone 95 Database Category	Winstone 95 Spreadsheet Category	Winstone 95 Business Graphics/Desktop Publishing Category	Winstone 95 Word Processing	CD-ROM Maximum Throughput
AcerPower 60MHz Pentium	2,772	436	8.7	9.5	10.0	9.2	307
AcUMA P66	3,111	644	10.6	11.4	11.2	9.5	300
Alaris Cougar*	6,582	305	8.3	7.1	7.3	8.6	331
AMAX 66 PowerStation	3,111	599	10.7	11.1	11.2	9.7	301
ATAS Pentium 66	4,861	601	10.2	11.1	11.0	10.0	300
AST Bravo P 60	3,111	560	9.4	8.4	11.5	9.5	301
AST Premium MX 4/100i	3,402	603	8.3	9.0	8.7	8.7	300
AT&T 59C	3,111	454	10.4	10.1	10.8	9.2	30
Austin Communications P66	5,108	580	12.7	13.6	14.3	12.1	301
Austin Educa	3,111	531	11.1	11.3	12.3	11.0	301
Austin Power 60	2,950	500	10.5	11.3	12.2	9.9	301
CAF Lightning P6	3,111	559	9.6	10.1	11.4	9.5	30
Compaq 566	656	605	10.3	10.9	11.6	10.5	300
CompuAdd CP50c	3,111	514	11.3	11.1	13.2	11.1	300
Comtrade Best Buy 566	5,102	584	10.7	11.6	11.3	9.8	301
Comtrade CAD Publishing 566	3,111	676	10.8	11.1	11.3	9.6	301
Cornell Power	4,900	523	9.2	9.5	8.9	8.0	373
DataStar P5 66	3,111	537	9.8	11.4	9.6	8.1	330
Dell Dimension P60	3,856	519	8.8	9.1	8.1	8.1	301
Dell OmniPlex 56C	3,111	527	9.0	11.1	11.7	8.3	197
Dell OptiPlex 4100 Lite	5,582	660	7.8	8.6	9.0	7.3	301
Diamond Tornado	3,111	597	10.5	11.1	11.7	10.6	301
DECpc 566	5,371	566	9.8	10.6	11.5	10.1	300
DTK Quir	3,111	448	8.2	11.1	9.7	8.5	301
Duracom 586/66	5,141	564	9.0	8.4	8.7	7.5	149
Epson P60	3,111	438	8.6	11.1	9.7	8.8	301
EPS Phantom	4,755	568	11.5	12.5	13.4	11.3	301
Ga n P56L	3,111	200	9.1	11.1	10.0	8.1	33
Gateway P5-60 Family PC	5,107	621	8.5	10.1	10.1	8.6	301
Gateway P5 6C	3,111	502	8	11.1	10.1	8.5	300
Hertz P66e	1,560	483	8.8	9.3	8.4	8.0	301
HQ P66 PC	3,111	614	9.7	11.4	10.1	8.8	301
IBM 100DX4/Dp	3,112	642	10.7	11.5	13.2	10.4	301
insight P66	3,111	521	12.8	11.1	14.5	12.2	301
Micro Express MicroFLEX-VL/P66 3 250		588	10.1	10.9	12.5	10.2	330
Micron 4100PC	5,056	613	11.7	11.1	13.8	11.5	301
MidWest Micro P5-66	6,881	683	10.3	11.2	11.0	9.4	300
Mitsuba 486DX4 100	2,905	490	7.9	11.1	8.4	7.7	300
NMC Expert-System	4,844	683	11.7	11.9	13.2	11.1	601
NEC PowerMate P60D	4,005	513	9.6	11.1	11.4	9.6	392
NETS N566 Best Buy	4,058	661	11.0	12.0	12.3	10.6	461
NET S N566 PowerStation	4,067	582	10.2	11.1	10.5	9.3	451
Olivetti MM-82	852	579	9.6	10.8	10.1	9.1	301
PC Express EXP100	6,455	509	8.2	11.1	7.8	7.7	301
PCG P60	3,776	480	9.3	10.4	9.5	8.9	335
Poly DX4 100P	4,326	477	10.1	11.1	12.3	10.4	300
Precision PTI-86	1,708	613	9.9	10.4	10.1	8.8	451
Robotech RS-DX4-100	5,983	210	8.4	11.1	10.2	8.7	301
Royal Media Master IV	3,888	626	9.9	11.3	10.8	9.4	451
Seamx 486DX499 1GL	5,307	611	10.3	11.1	12.3	9.7	300
Sidus SC986DC256DT	4,232	588	10.7	11.2	12.5	10.1	301
Sys Business	5,602	597	9.9	11.1	10.9	9.2	299
Tagram XL	8,273	508	8.2	10.1	11.6	9.6	601
Tangent DX4/100	4,813	527	10.5	11.1	13.0	10.4	301
Tri-Star Pentium 66	4,478	554	10.3	10.4	10.6	9.4	301
Unitex UT P60	4,065	534	9.4	11.1	10.9	8.9	301
Vektron Professional Multimedia 3 3561		350	7.8	8.9	8.9	8.0	449
Vektron PCI Power Station	3,766	524	8.9	11.1	9.4	8.0	300
Ximtron P66	2,235	520	8.9	10.6	11.6	10.2	331
ZEOS Pentium 66	5,111	645	12.1	11.1	14.7	12.4	301
AVERAGE	4,300	536	9.9	10.6	11.0	9.5	325

* The Alaris Cougar was the only tested PC based IBM's 75-MHz Blue Lightning CPU; all other systems here are based on faster processors.

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What the Numbers Mean

Among entry-level systems, the top Winstone 95 performers were the NETiS N466P Best Buy and the Tagram Thunderbolt ZR. Both came to us with IDE hard disks and Microsoft Windows for Workgroups; the tested Tagram system used a Tseng ET4000/W32P graphics accelerator, traditionally only an average performer. The poorest Winstone performers were hobbled by small or nonexistent L2 processor caches: only 128K for the Duracom 486DX2/66 and none whatsoever for the Epson Endeavor VL DX2/66.

The Winstone scores for 486DX2-based systems averaged only about half those of Pentium machines, partly because we had vendors configure them with only 8MB of RAM to reflect how they're often purchased.

Four of the five best performers on our Graphics WinMark 95 tests use S3 Vision964 chips on Diamond Stealth cards. Two entries tied for top honors: The Micron 466PCI Magnum and the ZEOS Pantera 486DX2-66. The odd man out among the leaders was the Royal 486/66 Media Master III, which had an ATI Graphics Ultra Pro card. At the bottom end were units with 32-bit Cirrus Logic GD5428 graphics engines; the worst performer, the Epson Endeavor VL DX2/66, was again hurt by its lack of an L2 processor cache.

IDE hard disks reigned supreme, and systems with them captured almost the entire top half of the Disk WinMark 95 results. The leading performers—the Tagram ZR and the Micron 466PCI—turned in scores that almost doubled those of the best SCSI-based entry, the DECpc XL 466d2.

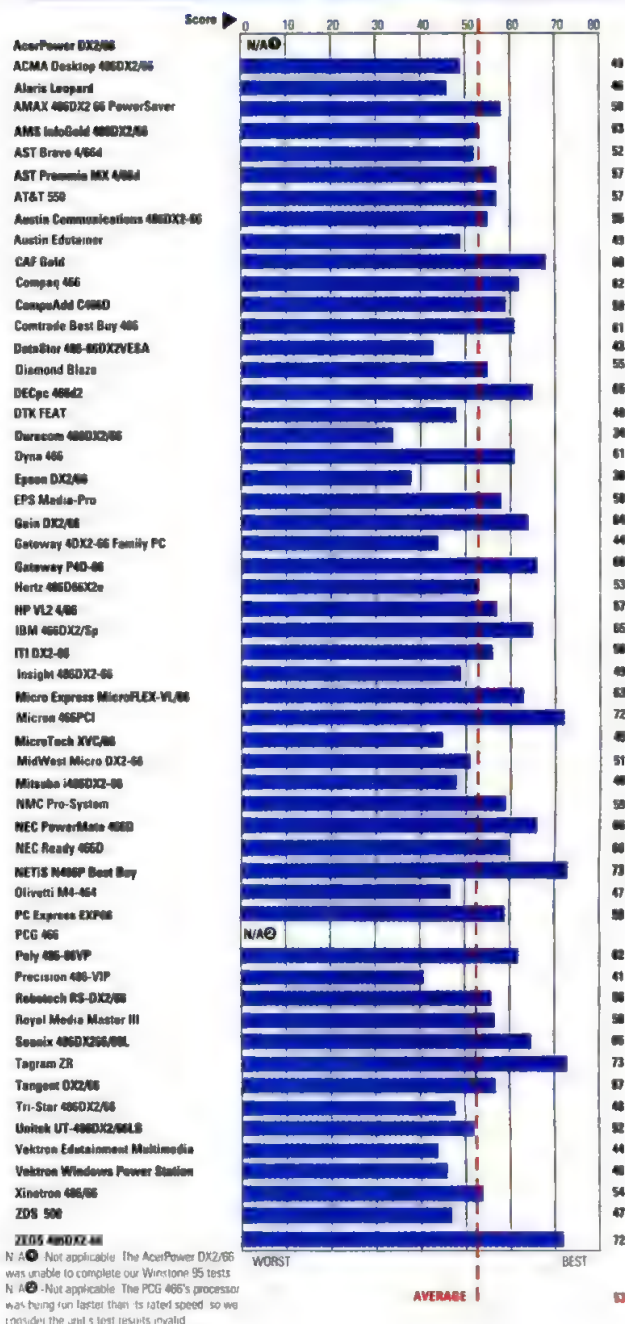
Our two best DOS performers, the Tagram ZR and the ZEOS 486DX2-66, pulled together good DOS graphics cards and fast IDE hard disks. The Tagram ZR was bolstered by the Tseng ET4000/W32P chip (a top performer under DOS) on its motherboard and a fast Maxtor MXT-540A IDE 503MB hard disk. The ZEOS 486DX2-66 uses the second-fastest graphics performer under DOS, the Diamond Stealth 64 VRAM, and a Seagate ST5660A IDE 545MB hard disk.

Systems using Intel's Saturn II chip sets had a definite advantage on our CPUmark₁₆ tests. The top-scoring Micron 466PCI, ZEOS 486DX-66, and Compaq Deskpro XL 466 Model 535/CDS each contain 256K of 15-ns L2 processor cache. Units with less cache fared worse.

For a detailed discussion of how we tested the systems, see the introduction to the benchmark test section.

—Analysis written by Richard Fisco

WINSTONE 95



Overview: Entry-Level Systems

By John Clyman

If you doubt the frenzied pace of progress in the computer industry, just look back a year. When we last performed a roundup this large (December 7, 1993), machines based on Intel's 486DX2/66 CPU had a stranglehold on the high end of the market. Now they're merely entry-level

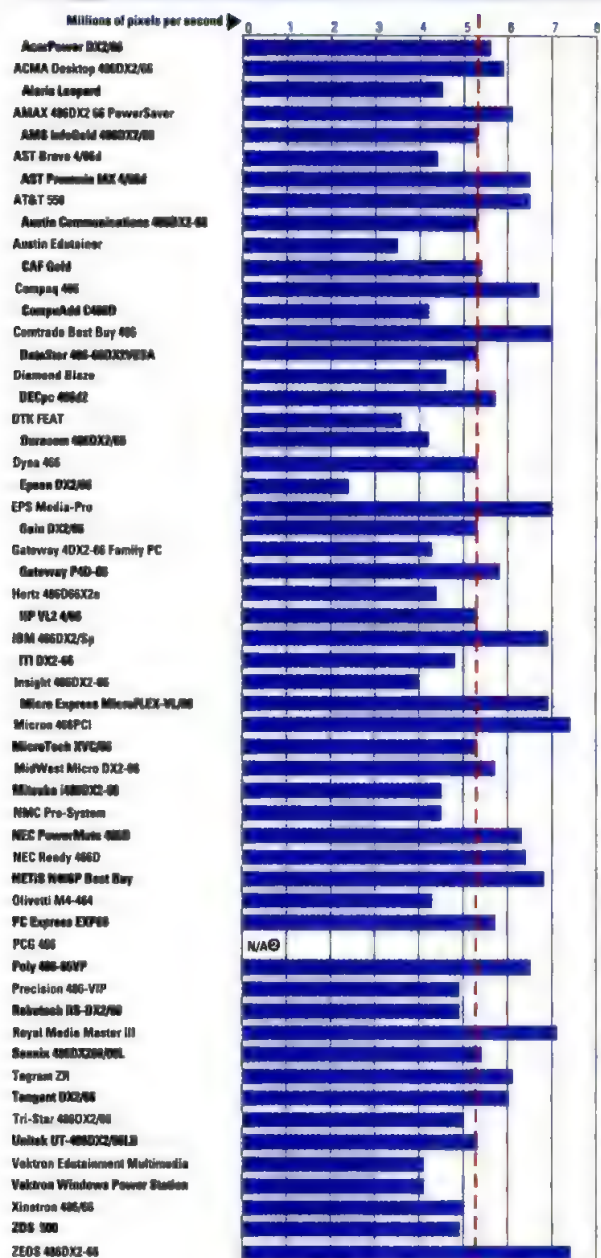
PCs—and on the verge of losing even that status.

As always, the upward ratcheting of the power ceiling has translated into more attractive prices at every power level. The average price of the 56 entry-level systems we tested is about \$2,200, and the two least expensive models, the American

Multisystems InfoGold 486DX2/66 and the Vektron Windows Power Station/486DX266, each come in under \$1,500. They're hardly stripped, either: Each comes with 8MB of RAM, a 340MB or larger hard disk, a double-speed CD-ROM drive, and a 14- or 15-inch color monitor.

These machines, and others at this level, offer performance that is adequate for everyday use. With average Winstone

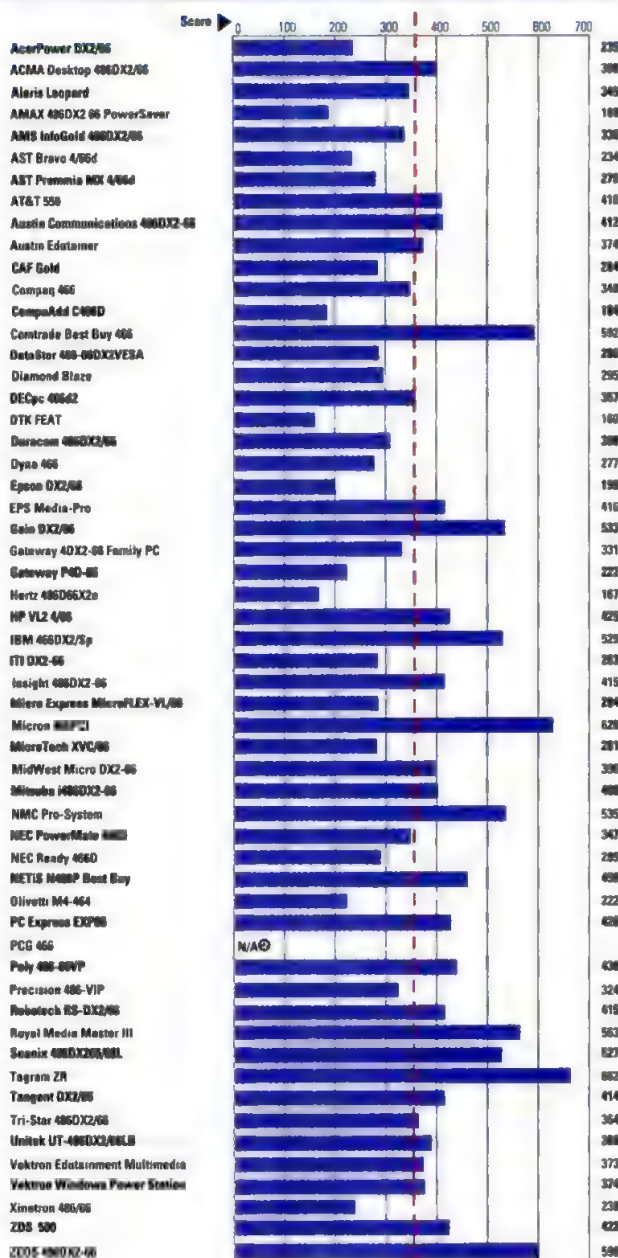
GRAPHICS WINMARK 95



N/A@—Not applicable. The PCG 466's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

5.4

DISK WINMARK 95



N/A@—Not applicable. The PCG 466's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

367

95 scores of 56, they're more than five times the speed of 386DX/25 machines and nearly half the speed of typical fully loaded 90-MHz Pentiums. Their DOS performance is high enough so that even the slowest system can accurately be labeled "fast enough."

PENTIUM ENVY

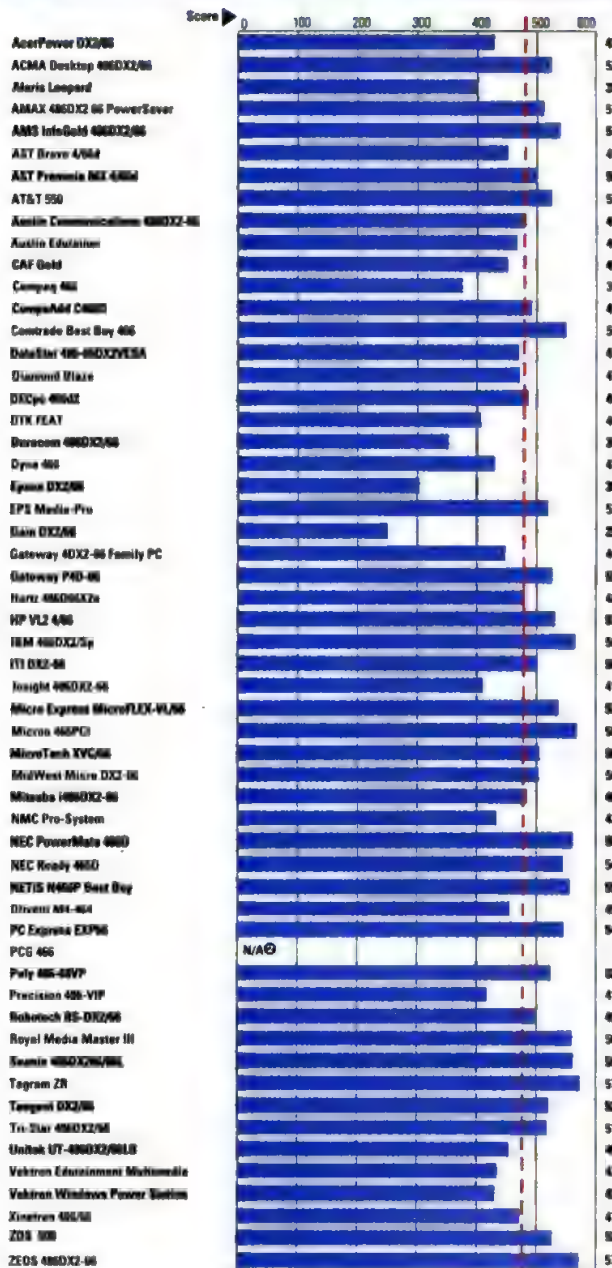
Given these appealing statistics, why consider a speedier, more expensive system

at all? If you're pinching pennies or you're a business user with no intention of exploring multimedia, there may be little reason. But beware of false economies: Skimping now may mean you'll end up buying a replacement PC sooner than you think. Already the snazziest games and educational programs place stringent demands on hardware. In another year, you can expect 486 systems to be considered relics.

The price differential between an entry-level system and the next step up—a DX4/100, Pentium/60, or Pentium/66 machine—is relatively small. The average midrange system we tested costs about \$1,000 more than the average low-end system, despite an additional 8MB of RAM and 200MB of hard disk capacity (along with a near doubling of overall Windows performance).

These entry-level systems still pre-

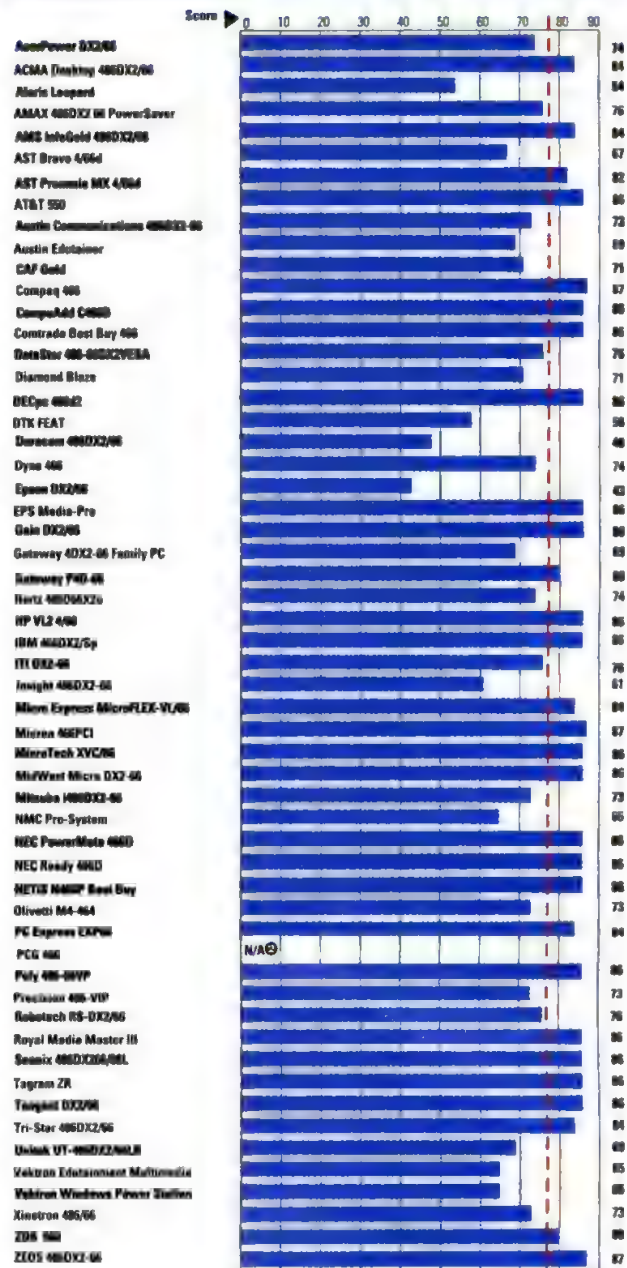
DOSMARK



N/A: Not applicable. The PCG 486's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

AVERAGE 485

CPUMARK16



N/A: Not applicable. The PCG 486's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

AVERAGE 77

dominantly use the VESA local bus rather than PCI. Although the two buses are nearly equivalent in terms of theoretical peak performance, we think PCI has a stronger future. Gateway 2000, for instance, has stopped selling VL-Bus systems.

Typically, entry-level systems also offer less expansion room than more powerful machines; many are housed in slim-line cases. But extensive expandability

may be less critical a concern than in the past, because many components (such as I/O and disk controllers) are now routinely integrated onto motherboards. Often, three available expansion-bus slots on a riser card will be sufficient in a low-end system. One bay in addition to those filled by the CD-ROM drive and floppy disk drive will prove adequate for most users.

Traditionally, graphics accelerators have been the only components manufac-

turers were unwilling to integrate. Eleven of these entry-level systems, however, provide integrated graphics accelerators; these designs didn't fall consistently above or below the average during our testing.

A LOOK AT THE SYSTEMS

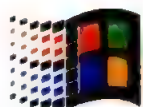
All of the entry-level systems but one use an Intel 486DX2/66 CPU; the exception comes from Alaris, which partnered with

LEGENDARY PERFORMANCE



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SILICON TO SYSTEMS

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POWERFUL



Optional full sized tower pictured in addition to desktop.

MICRON

SILICON TO SYSTEMS



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October 1994
POWERSTATION



June 28, 1994
POWERSTATION



October 1994
MAGNUM

SOLUTIONS

P90PCI

PC World called Micron's P90PCI PowerStation "a screamer." It outscored all the competition in PC Magazine's, Winstone 94, Disk Winmark and Disk benchmark tests. With 90MHz of Pentium™ processor performance and the lowest prices anywhere, your toughest decision will only be which Micron model to buy.

POWERSTATION

- Intel™ 90MHz Pentium™ processor
- 256K write-back cache, Flash BIOS
- 2X CD-ROM drive, 3.5" floppy
- PCI 64-bit graphics accelerator (2MB)
- "Tool-free" desktop or mini-tower
- Microsoft® Mouse, 101-key keyboard
- MS-DOS® & Windows® for Workgroups

- A • 8MB RAM, 527MB IDE hard drive
- 15" Micron 15FGx, 1280NI, .28mm
- Microsoft Works Multimedia CD

\$2,299 (Lease \$79/month)

- B • 16MB RAM, 730MB IDE hard drive
- 15" Micron 15FGx, 1280NI, .28mm
- Microsoft Office Professional 4.3 CD

\$2,899 (Lease \$99/month)

- C • 32MB RAM, 1GB IDE hard drive
- 17" Micron 17FGx, 1280NI, .28mm
- Microsoft Office Professional 4.3 CD

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- Intel 90MHz Pentium processor
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- PCI 32-bit Fast SCSI-2 controller
- 4X SCSI-2 CD-ROM drive, 3.5" floppy
- PCI 64-bit graphics accelerator (2MB)
- "Tool-free" desktop or mini-tower
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
- Microsoft Office Professional 4.3 CD

- A • 16MB RAM, 1GB SCSI-2 hard drive
- 15" Micron 15FGx, 1280NI, .28mm

\$3,499 (Lease \$113/month)

- B • 32MB RAM, 2GB SCSI-2 hard drive
- 15" Micron 15FGx, 1280NI, .28mm

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* Not available in desktop.

POPULAR CHOICES

"Once in a while a company really hits all the hot buttons for PC buyers," said PC Magazine. The Micron family of 486 systems is no exception, offering superb performance and highly reliable systems starting at under \$1,200. Complete. See for yourself why PC World said "... the 466VL came with everything we've come to expect in a high-performance machine."

466PCI MAGNUM

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- 2X CD-ROM drive, 3.5" floppy drive
- "Tool Free" desktop or mini-tower
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups

466VL
SAME I

A • 8MB RAM

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- PCI graphics accelerator (1MB)
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- Microsoft Works Multimedia CD

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B • 16MB RAM

- 730MB 12ms IDE
- PCI graphics accelerator
- 15" Micron 15FGx
- Microsoft Office Professional

\$2,399
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Every Micron Home MPC comes free with Microsoft Encarta CD, Microsoft Works Multimedia CD and Quicken Deluxe Edition CD. You also get the latest CD games from LucasArts: Rebel Assault, Day of the Tentacle, and Indiana Jones and the Fate of Atlantis. Along with trial subscriptions for CompuServe, America Online and Prodigy. All included in the one low affordable system price.

P90 HOME MPC

- Intel Pentium 90MHz processor
- 8MB RAM, 256K write-back cache
- 527MB 12ms IDE hard drive (PCI)
- 2X CD-ROM drive, 3.5" floppy drive
- SoundBlaster 16 sound card, speakers & joystick
- 14.4/9600 Fax/Modem & WinFax Lite
- PCI 64-bit graphics accelerator (2MB)

- 14" Micron 14FG, 1024NI, 28mm
- "Tool-Free" desktop or mini-tower
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
- Microsoft Works Multimedia CD, Microsoft Encarta CD, Quicken Deluxe Edition CD
- Trial subscriptions for CompuServe, America OnLine & Prodigy
- LucasArts CD games: Rebel Assault, Day of the Tentacle, Indiana Jones and the Fate of Atlantis

\$2,499



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- LucasArts CD Games: Rebel Assault, Day of the Tentacle, Indiana Jones and the Fate of Atlantis **\$199**

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- 14" Micron 14FG, 1024NI, 28mm
- Low profile chassis
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
- Microsoft Works Multimedia CD, Microsoft Encarta CD, Quicken Deluxe Edition CD
- Trial subscriptions for CompuServe, America OnLine & Prodigy
- LucasArts CD games: Rebel Assault, Day of the Tentacle, Indiana Jones and the Fate of Atlantis

- A • Intel 486SX 33MHz processor
- 4MB RAM (expandable to 48MB)
- 210MB 14ms IDE hard drive

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- B • Intel 486DX2 66MHz processor
- 8MB RAM, 128K cache
- 420MB 14ms IDE hard drive

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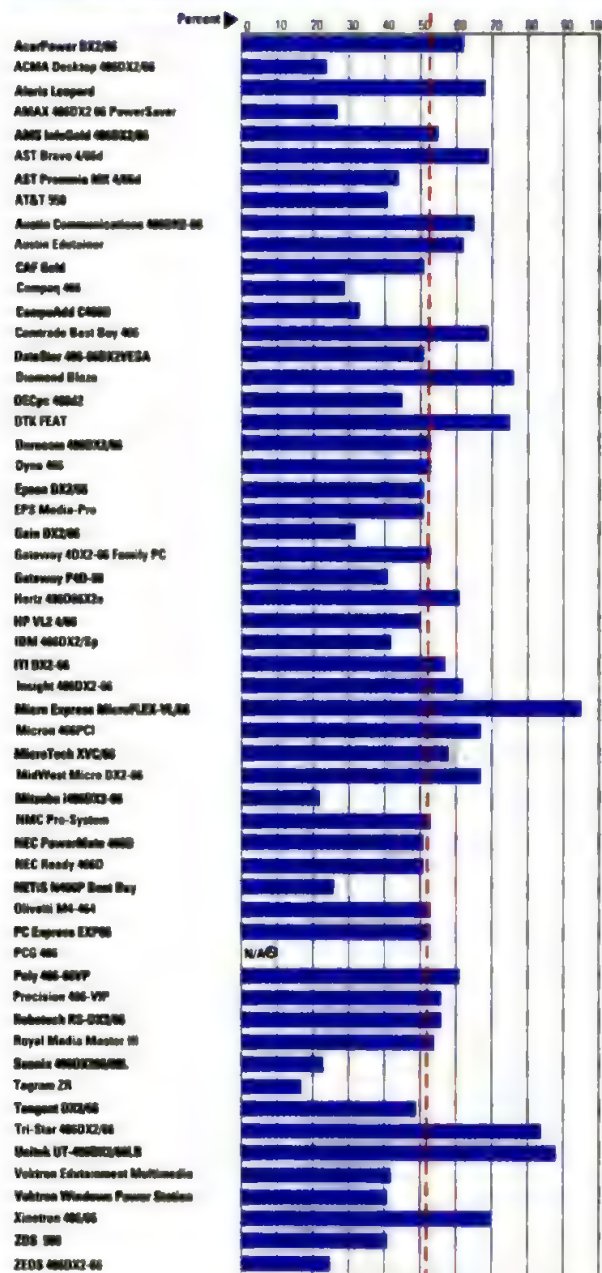
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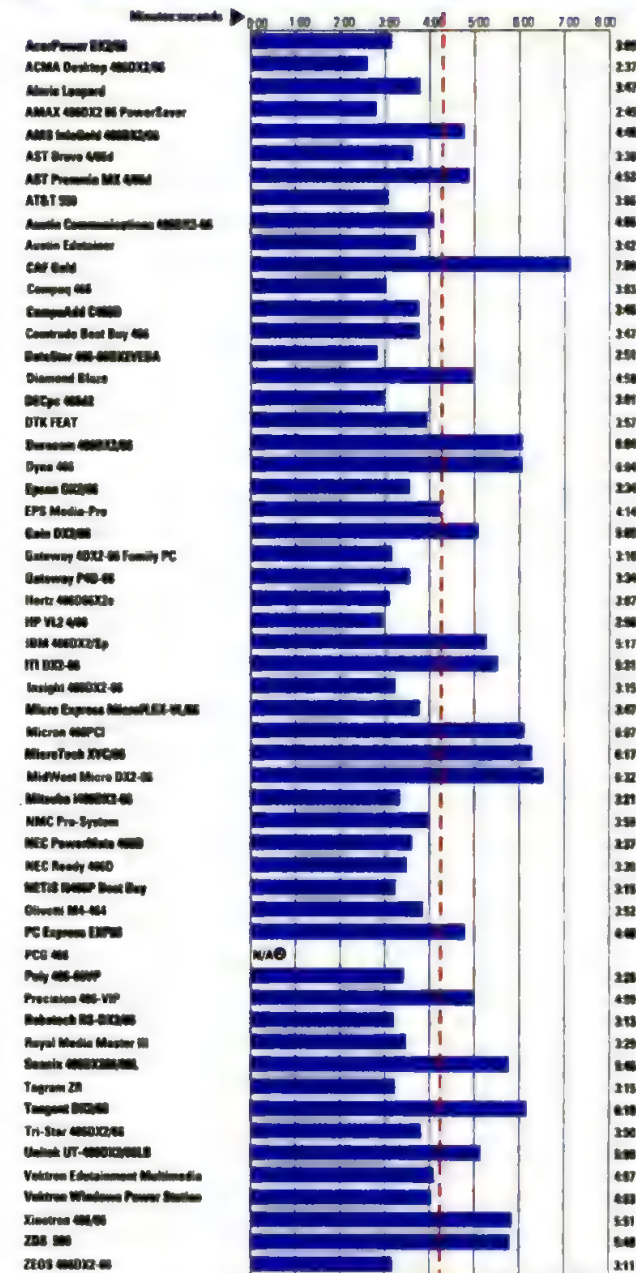
N/A: Not applicable. The PCG 486's processor was running faster than its rated speed, so we consider the unit's test results invalid.

AVERAGE

WORST

52

CD-ROM DATABASE SEARCH



N/A: Not applicable. The PCG 486's processor was running faster than its rated speed, so we consider the unit's test results invalid.

AVERAGE

WORST

4:13

IBM to build motherboards based on IBM's own 486 CPU line. (Under its agreements with Intel, IBM cannot sell stand-alone 486 CPUs.) The Alaris Leopard Plus EnergySmartPC 486SLC2/66 uses an IBM 486SLC2/66 CPU, which—like the Intel 486DX2/66—runs internally at a clock-doubled 66 MHz. But unlike the Intel component, IBM's product has only a 16-bit data bus, which accounts for the Alaris system's poor CPUmark₁₆ score. The system's

Winstone score was slightly below average.

Nearly all the systems offer high-speed expansion buses. Three, however, do not: The Austin Edutainer, the Gateway 2000 4DX2-66 Family PC, and the HP Vectra VL2 4/66. We think not including a high-speed bus is shortsighted.

Many entry-level PCs are designed to fulfill specific market needs. The Austin Communications Manager 4DX2-66 provides telephony capabilities that small- or

home-office users should find appealing. The recently revised Compaq Presario CDS 520, which arrived too late for this roundup, provides similar capabilities and adds a television hookup. (Compaq Presario CDS 520s are currently available only with 486DX2 CPUs.)

The bottom line: With the prices and performance shown here, it's clear that "entry-level" is no longer a euphemism for "underpowered."

	DOS Video	DOS Disk	Winstone 95 Versions Category	Winstone 95 Spreadsheet Category	Winstone 95 Business Graphics/ Desktop/ Publishing Category	Winstone 95 Word Processing Category	CD-ROM Maximum Throughput
AcerPower DX2/66	2,807	385	N/A	N/A	N/A	N/A	300
ACMA Desktop 486DX2/66	4,592	393	4.3	5.2	5.5	4.7	301
Alaris Lamped	7,127	341	3.8	4.8	5.0	4.7	301
AMAX 486DX2 66 PowerSaver	4,864	411	5.3	6.2	6.1	5.7	300
American Multisystems InfoGold 486DX2/66	4,616	421	4.7	5.2	5.8	5.4	300
AST Bravo 4/66d	4,346	395	4.3	5.3	5.7	5.5	301
AST Premium MX 4/66d	3,380	389	4.7	5.8	6.1	6.1	300
AT&T 550	3,454	405	4.7	5.8	6.2	6.1	301
Austin Communications 486DX2-66	5,367	386	4.5	5.7	5.9	5.9	300
Austin Edutainer	4,346	386	4.1	5.1	5.7	4.8	300
CAF Gold	2,803	384	3.1	5.9	7.5	6.6	301
Compaq 486	584	428	5.1	6.3	6.8	6.8	301
CompaqAdd C486D	3,677	314	5.9	8.2	8.3	5.7	300
Comtrade Best Buy 486	3,264	467	5.2	6.6	6.7	6.0	301
Calcomp 486-486DX2/66	5,380	422	3.7	4.6	4.7	4.4	320
Diamond Blaze	5,364	374	4.8	5.6	6.2	5.7	301
ESXpc 486/2	1,704	427	6.8	8.6	6.9	6.8	300
DTK FEAT	4,018	363	4.3	5.1	5.3	4.7	300
Seimens 486DX2/66	4,386	332	3.9	3.5	3.7	3.4	301
Dyna 486	5,006	281	5.1	6.2	6.6	6.5	300
Epson DX2/66	3,490	399	3.1	3.8	4.4	3.9	301
EPS Media-Pro	5,156	363	4.7	6.0	6.5	6.2	301
Gain DX2/66	1,581	118	5.4	4.5	7.1	6.6	321
Gateway 4DX2-66 Family PC	4,434	347	3.7	4.7	4.7	4.5	301
Gateway P40-66	3,969	439	6.1	8.8	7.8	6.4	301
Hertz 486DX2/66	4,519	377	4.9	5.5	5.7	5.2	302
HPV42 4/66	4,614	462	4.7	5.9	6.3	6.0	300
IBM 486DX2/Sp	5,227	446	5.4	6.7	7.1	6.6	300
IT-8X2-66	5,857	367	4.8	5.7	6.2	5.9	300
Insight 486DX2-66	4,811	328	4.1	4.9	5.8	5.1	301
Micro Express MicroFlex-VL/66	4,458	325	5.2	6.4	6.8	6.5	301
Micron 486PCI	5,028	448	6.0	7.6	7.9	7.5	301
MicroTech XVC/66	4,671	345	3.8	4.8	4.9	4.7	300
MidWest Micro DX2-66	4,360	354	4.3	5.4	5.5	5.2	301
Minisys 486DX2-66	5,450	393	4.9	6.1	6.4	4.9	301
NVC Pro-System	6,416	327	4.9	6.0	6.8	6.1	301
NEC PowerMate 486D	7,980	458	5.4	6.7	7.2	7.0	301
NEC Ready 486D	7,125	388	4.9	6.1	6.6	6.5	300
NETS 1486P Best Buy	4,911	491	5.9	7.7	7.8	7.8	299
Olivero M4-464	4,882	331	3.7	4.8	5.2	5.1	301
PC Express C/P486	6,889	311	3.8	6.0	6.8	6.1	301
PCG 486	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Peggy 486-66	4,639	339	5.9	6.4	7.0	6.5	300
Precision 486-VIP	1,833	368	3.5	4.3	4.3	4.1	300
Rohdebach RS-DX2/66	5,859	376	4.8	5.9	6.2	6.8	300
Royal Media Master III	4,383	463	4.9	6.3	6.3	5.7	300
Seamix 486DX2/66	5,274	447	5.8	6.8	7.3	6.7	300
Tagram ZR	6,712	450	6.2	7.4	8.2	7.5	301
Targent DX2/66	6,283	383	4.8	6.8	6.8	6.1	300
Tri-Star 486DX2/66	4,462	389	4.1	5.1	5.3	4.7	301
Unitek UT-486DX2/66B	4,623	358	4.1	5.4	6.5	6.5	300
Vektoron Edutainment Multimedia	4,880	338	3.7	4.7	5.0	4.5	294
Vektoron WinMark Pro Edition	4,880	338	3.7	4.7	5.0	4.5	301
Xinetron 486/66	5,301	354	4.4	5.5	5.9	5.7	300
ZEOS 486DX2-66	4,305	475	6.0	7.6	7.9	7.6	301
AVERAGE	4,613	377	4.7	5.8	6.1	5.7	302

N/A —Not applicable. The AcerPower DX2/66 was unable to complete our Winstone 95 tests.

N/A —Not applicable. The PCG 486's processor was being run faster than its rated speed, so we consider the unit's test results invalid.

Acer America Corp.

● AcerPower

Acer America Corp.'s AcerPower PCs come loaded for general-purpose and multimedia computing in businesses or homes. Average to below-average performers for their tiers, the Acer units—in no-tools mini-tower cases—are fair values. Each system in the line comes with a double-speed CD-ROM drive; a Sound Blaster 16 card; speakers; and a 14.4-Kbps fax modem, fully set up for multimedia and telecommunications applications, including voice mail. For those looking for basic entry-level systems, Acer offers its Acros line (not reviewed here).

The AcerPower DX2/66—based on a combination VL-Bus/PCI design—lists for \$2,149. It was unable to complete the Winstone 95 tests. Its scores on both disk tests were below average. Using an ATI Graphics ProTurbo card with 2MB of VRAM, the unit got an average Graphics WinMark 95 score.

The PCI-based \$3,199 AcerPower 60MHz Pentium had average scores on the Winstone test, but its Disk WinMark 95 score was nearly the lowest of its group. Its Graphics WinMark score was average.

Poor disk performance also held back the \$3,599 AcerPower 90MHz Pentium. The unit had a below-average Disk WinMark score. The 90MHz Pentium's Graphics WinMark and Winstone scores were both average for its class.

—Bruce Brown

► **Acer America Corp., San Jose, CA; 800-368-2237, 408-432-6200; fax, 408-922-2953.**

Circle 523 on reader service card

IN SHORT	
AcerPower	
<i>Below-average performers with sound and telephony capabilities.</i>	
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
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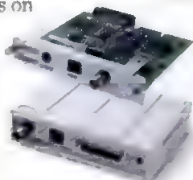
If you've been looking high and low for a way to get all your printers on the network, rest your eyes here for a moment. Because the HP JetDirect family of print servers has a solution that works with

the printers in your company. Not to mention virtually any LAN environment.

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Pentium and 486 Buyers' Guide

ACMA Computers Inc.

● ACMA Desktop Series

The peripheral-loaded systems we tested from ACMA Computers were mainly average performers in their groups, and are all competitively priced as configured.

The entry-level ACMA comes in a mini-tower case, while the midrange and high-end units come in tower cases. All provide enough drive bays for even more devices. Each had a double-speed Chinon CD-ROM drive, Sound Blaster 16 card, speakers, and a tiny microphone. Each of the ACMA models includes the company's own (\$199) internal PCMCIA card reader, which can accommodate one Type II and one Type III card.

On our tests, the \$2,295 ACMA Desktop 486DX2/66 produced an above-average CPUmark₁₆ score for its group; its Winstone 95 and Graphics WinMark 95 scores were average as well. This system—with a Conner CFA540A 503MB IDE hard disk—produced above-average DOS Disk and Disk WinMark 95 scores.

The \$3,395 ACMA P66 Tower system—using the same hard disk as the 486DX2/66—produced one of the top Disk WinMark scores in the midrange group. The system's Graphics WinMark and Winstone scores were average.

The \$3,895 ACMA P90 Tower, equipped with a 1GB Conner hard disk and a Diamond Stealth 64 PCI graphics board with 2MB of VRAM, produced mostly average scores compared with the high-end unit averages.—BB

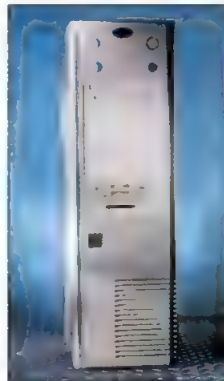
► **ACMA Computers Inc.**, Fremont, CA; 800-786-6888, 510-623-1212; fax, 510-623-0818.

Circle 524 on reader service card

IN SHORT

ACMA Desktop Series

Well-priced, average performers that come loaded with lots of peripherals.



Alaris Inc.

● Alaris EnergySmartPC Plus

Alaris, formerly a manufacturer of motherboards using IBM's Blue Lightning CPUs, is now selling whole PCs—based largely on IBM components. With most sales through VARs, system integrators, and regional distributors, Alaris targets companies that want to buy totally U.S.-assembled, Energy Star-compliant PCs. Alaris doesn't stress high performance as much as quality and reliability, with a three-year warranty on the IBM-made CPUs and ISA/VL-Bus motherboards (one year on other parts).

The \$1,969 Alaris Leopard Plus EnergySmartPC 486SLC2 66 desktop—which uses an IBM 486SLC2 CPU—is not as fast as most of the entry-level units tested (as shown by its below-average CPUmark₁₆ score). The Leopard is intended for low-end to midrange business users. This unit's scores on our Windows-based tests were all average to just below average. DOS-based test scores ranged from aver-

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age to below average, except for the DOS Video score, which was above average.

The \$2,239 Alaris Cougar EnergySmartPC 486BL3X 75 is based on a 75-MHz IBM 486BL3X CPU and is targeted at business users seeking a system that offers moderate performance.

On our Winstone 95 tests, the Cougar's score fell between the entry-level system average and the midrange system average. The system's CPUmark₁₆ score was well below average for a mid-range unit, however.—BB

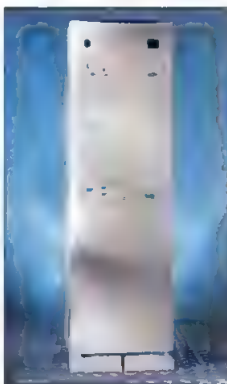
► **Alaris Inc., Fremont, CA;** 510-770-5700; fax, 510-770-5769.

Circle 525 on reader service card

IN SHORT

Alaris EnergySmartPC Plus

Reasonably priced Energy Star-compliant PCs with slow IBM processors.



AMAX Engineering Corp.

• AMAX PowerStation

AMAX Engineering Corp. sent us three systems. The \$3,999 AMAX 90 PowerStation, an ISA/PCI unit with a 1GB hard disk, a Pentium/90 CPU, a 17-inch monitor, a fax modem, a Sound Blaster 16 card, a network card, and two PCMCIA slots, is aimed at high-end power users. The \$3,460 AMAX 66 PowerStation offers the same equipment as the 90 PowerStation but with a 540MB hard disk and Pentium/60 CPU, and it targets general business or home users. The \$2,049 AMAX 486DX2 66 PowerSaver, an ISA/VL-Bus PC, has a 15-inch monitor, a 540MB hard disk, and no network card but is otherwise the same as the others and is for homes or small businesses.

Both Pentium PCs have roomy towers that integrate I/O, floppy disk, and hard disk controllers. The 486DX2 66 PowerSaver mini-tower has less space and fewer slots. Two ISA slots are prevented from using full- or three-quarter-length cards. I/O and disk controllers are on a VL-Bus

card. The ports from this card are run out of a neighboring backplate, blocking that ISA slot. The other VL-Bus slot is taken by a graphics card; only one ISA slot is open.

Winstone 95 scores for the Pentium PowerStations were average within their groups; both managed average to above-

IN SHORT

Amaz PowerStation

Above-average performers for home, business, and power users.



average scores on the rest of our tests. The 486-DX2 66 PowerSaver posted average marks on all but our Disk WinMark 95 tests, where it fared below average. —Anush Yeghazarian

► **AMAX Engineering Corp., Fremont, CA;** 800-800-6328, 518-651-8886; fax, 510-651-4119.

Circle 444 on reader service card

Environmental Engineering

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Multi-synchronous and available with PC, Mac II, Quadra and LC compatibility, Goldstar monitors are backed by an outstanding warranty and the power of one of the world's leading monitor companies. So take a look at the new 1994 monitors from Goldstar - they're perfectly engineered for a growing part of your business.

GoldStar

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Model 1723 - 17" FST, auto-scan,
MPR II, 96-254 VAC, digital controls



Goldstar U.S.A., Inc. 1000 Sylvan Avenue, Englewood Cliffs, NJ 07632

CIRCLE 371 ON READER SERVICE CARD



100 MHz and Beyond

By Christopher Barr

By the time Intel produces the 100-MHz Pentium processor in volume, it may no longer be the hottest chip around. Pentium alternatives from Intel's competitors—some already shipping, some due soon—promise to be just as fast, and in some cases less expensive. The Pentium was the first x86 chip to incorporate such performance-enhancing features as a superscalar design and branch prediction, but these Pentium challengers add even more technological advances in the attempt to break Intel's lock on the high end of the desktop PC market.

Advanced Micro Devices and Cyrix Corp. both plan to release 100-MHz or faster processors during 1995, but the first company to produce a Pentium-class CPU is NexGen. NexGen's four announced CPUs—the Nx586-P75, Nx586-P80, Nx586-P90, and Nx586-P100—take their names from an unusual source. The "586" moniker is straightforward enough, but the "P75" through "P100" suffixes do not denote the processor's clock frequency. Instead, NexGen names each chip based on the clock speed of the Pentium that would most closely match it in performance.

NexGen's Nx586-P100 actually runs at 93 MHz, but NexGen feels it provides equivalent performance to Intel's 100-MHz Pentium. The true clock speeds of the CPUs are about 7 percent lower than their names imply. In our tests of a preproduction Nx586-based system from Tangent Computer, we found its Winstone 95 performance to be on a par with the Pentium/90 systems tested for this roundup.

The Nx586 has a number of features that set it apart from Pentium. Its on-board cache is 32K, or twice the size of Pentium's. And the Nx586 includes an external cache controller, which potentially can improve performance and lower the cost of supporting circuitry. On the other hand, early

Nx586 CPUs don't have an integrated floating-point unit, although subsequent designs will have one incorporated into a multichip module that will plug into the same motherboard socket as the standard Nx586 chip.

One factor that may delay the Nx586's acceptance is its proprietary

*We found the Winstone
95 performance of a pre-
production Nx586-based
system to be on a par
with that of the
Pentium/90s tested here.*

pin-out, which requires a special motherboard design. You can't simply drop it onto a system that was designed for a Pentium.

BRIDGING THE GAP

Two significant bottlenecks of x86 chips are a limited register set and variable-length instructions, remnants of a CISC design that originated in the late 1970s. AMD, Cyrix, and NexGen all incorporate register-renaming techniques to overcome the first deficiency. (Register renaming helps the CPU resolve dependencies that occur when two instructions need to work with the same register.) And AMD and NexGen employ a RISC-like internal design that remaps variable-length x86 instructions into fixed-length instructions that can be more efficiently processed.

AMD's K5 series, which is pin-compatible with Pentium, will debut at 100 MHz in 1995 and reach 150 MHz in 1996. The K5 will use a design that can issue up to four instructions simultaneously and will allow instructions to be issued and completed out of order

to improve performance. As a result, AMD claims, a K5 processor will outperform a Pentium at the same clock frequency by 30 percent.

Using a 24K level 1 cache, which is divided between a 16K instruction cache and an 8K data cache, K5's on-board cache is larger than Pentium's but smaller than NexGen's. K5 will not have an internal L2 cache controller as the NexGen chip does.

Cyrix's M1, expected early in 1995, will be a 100-MHz CPU that shares many of these advanced features. Among those features will be dual seven-stage integer pipelines and a unified level 1 cache (a primary data cache and a secondary instruction cache) as well as a 256-byte, fully-associative microcache acting as the instruction-line cache. Cyrix claims the M1 will outperform the Pentium by 30 to 50 percent at identical clock rates when running uncompiled x86 binaries.

Intel, of course, won't be standing still for the competition. In later 1995, you can expect to start hearing news of yet-faster Pentiums and the first hints about Pentium's successor, code-named P6. It won't be until near the end of the century, though, that we see the fruit of Intel's recent alliance with Hewlett-Packard to develop a new breed of microprocessor.

"REAL MEN HAVE FABs"

Does the technical prowess shown by AMD, Cyrix, and NexGen really threaten Intel's dominance? In theory, perhaps, but Intel still holds a potentially critical trump card: fabrication facilities. AMD has factories to build K5 chips but can't produce the millions of chips that Intel makes annually. Neither NexGen nor Cyrix owns a fabrication plant, and both have contracted with IBM Microelectronics to build chips. The importance of sufficient capacity has prompted an industry observer to quip, "Real men have fabs." □

THUNDERBOLT POWER & WINNING PERFORMANCE

On Both DOS & Windows Applications!



June 28, 1994
Tagram Thunderbolt XL

HERE IS THE PROOF!

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"if your workday finds you toggling between DOS and Windows, look to the Tagram Thunderbolt XL, a PC that performed equally well in both environments."

—PC Magazine, June 28, 1994



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- Intel® Pentium™ Processor, 256K Write Back Cache
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- PCI W32P Graphics Accelerator w/1MB
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- 14" NI SVGA Monitor
- 1.44MB Floppy Drive/Keyboard/Mouse
- 8 bay Mid-tower w/250 Watt, 3 PCI, 2 VLB, 3 ISA
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60MHz **\$2899**
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| • Electronic Cookbook | • Electronic Cookbook |
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| • Dictionary | • Dictionary |
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CIRCLE 191 ON READER SERVICE CARD

TAGRAM
system Corporation

Tagram System Corporation • 1451 B Ellinger Ave., Suite, CA 94020 • Tel: 714 958-2226 • Fax: 714 958-8020 • Toll: 800-824-7267 • 714 958-7118 • Mon.-Fri.: 9am-5pm
Sat.: 9am-4pm (P.S.T.) • CISA Contract #: 00K34AGS • The Intel Inside Logo is a registered trademark of Intel Corporation. All trademarks and registered names are properties of their
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Pentium and 486 Buyers' Guide

American Multisystems Inc.

American Multisystems InfoGold

American Multisystems' InfoGold PCs, housed in different-size black tower cases, were average to strong performers on our tests. Combine that performance with solid components and low prices, and you have a series of good buys.

The \$1,495 InfoGold 486DX2/66, in a six-bay mini-tower case, is aimed at basic business and home use. This ISA/VL-Bus unit includes a 494MB Quantum ProDrive LPS540A hard disk, a Diamond Stealth 24 VL-Bus-based graphics card with 1MB of VRAM, and a 14-inch monitor. Its scores on our benchmark tests were average for its entry-level group.

With the \$2,500 InfoGold Pentium/66 system, you get an eight-bay medium-size tower case, ISA/PCI-based motherboard, and the same hard disk and monitor as the 486DX2/66—plus a Diamond Stealth 64 graphics card with 2MB of VRAM. This midrange system is targeted at graphics-intensive users, and it serves its purpose well: its Graphics WinMark 95 score was in the top ten for its group, as was its CPUmark₁₆ score. The Pentium/66's Winstone 95 score was slightly above average.

American Multisystems addresses the high end of the market with the InfoGold Pentium/90: A \$4,295 system in a full-size tower case with seven drive bays, a Diamond Stealth 64 graphics card with 2MB of

IN SHORT

American Multisystems InfoGold

These strong performers are geared toward graphics applications.



VRAM, a 1.7GB SCSI hard disk, and a 15-inch monitor. The unit turned in top-ten Winstone, CPUmark₁₆, and Graphics WinMark scores and average scores on our other tests.—BB

► **American Multisystems Inc.**, Sunnyvale, CA; 800-888-6615, 408-524-9091; fax, 408-524-9099.

Circle 445 on reader service card

AST Research Inc.

AST Bravo

The Bravo line from AST Research addresses two business market tiers. Those wanting a basic system will be interested in the Bravo LC series, AST's value line. The Bravo MS series is directed toward people who need more than a bare-bones PC but don't require the higher performance levels of the top-tier AST Premmia line (reviewed separately). AST also sells its Advantage line (not reviewed but similar to the Bravo line) through consumer channels. The Bravo LC and Bravo MS PCs

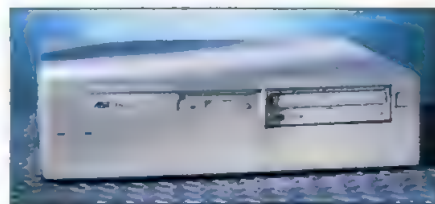
IN SHORT

AST Bravo

Basically average performers geared toward value-conscious buyers.

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE



were average performers in their respective tiers, and they are often available for much less than their list prices of \$2,263 and \$3,169, respectively, for the 486DX2/66- and Pentium/60-based units we tested. The Bravo systems are backed by a three-year warranty that includes on-site service for the first year.

The desktop Bravo LC 4/66d is an ISA/VL-Bus PC. It used an integrated Cirrus Logic video accelerator chip with 1MB of DRAM and a 404MB Western Digital hard disk. On our tests, the Bravo LC 4/66d was an average performer; its only below-average score was posted on the Disk WinMark 95 tests.

The 60-MHz Pentium-based slimline Bravo MS P/60 uses an ISA/PCI bus design. Like the 4/66 d, this unit has an integrated Cirrus Logic video chip (but with 2MB of DRAM). The P/60's performance results were average on all of our tests.—BB

► **AST Research Inc.**, Irvine, CA; 800-876-4278, 714-727-4141; fax, 800-926-1278.

Circle 446 on reader service card

AST Research Inc.

AST Premmia

AST Research's high-end PC line, the Premmia series, is targeted at demanding users who are willing to pay for extra features. Fairly priced, given their component quality and design features, the Premmias were average performers within their groups. Disk performance on our tests was weak, but AST says it uses SCSI disks to provide superior performance under 32-bit operating systems.

The MX models are aimed at the high-performance graphics market, while the GX models are for those who want workstation-level PCs with the works—including an EISA bus, integrated SCSI, and an integrated 10BaseT connector. The Premmias came in desktop cases and had ATI Graphics Pro Turbo 64-bit graphics cards.

The \$2,880 Premmia MX 4/66d came with a 404MB hard disk and 2MB of VRAM and attained an average Winstone 95 score for its group. The unit posted a below-average Disk WinMark 95 score for its group, but an average score on our Graphics WinMark 95 tests.

The \$3,770 Premmia MX 4/100t was configured identically to the MX 4/66d model, except for its 731MB hard disk. Compared with other midrange systems, the MX 4/100t posted below-average Winstone and Disk WinMark scores, and an average Graphics WinMark score.

The \$5,270 Premmia GX P/90 posted average Winstone and Graphics WinMark scores and a below-average Disk WinMark score—BB

► **AST Research Inc.**, Irvine, CA; 800-876-4278, 714-727-4141; fax, 800-926-1278.

Circle 446 on reader service card

IN SHORT

AST Premmia

Premmia systems designed for high-end applications and power users.

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE



AT&T Global Information Solutions

• AT&T Globalyst

AT&T Global Information Solutions' Globalyst PC line (engineered by the former NCR, which is why we cite service and reliability scores for both) is divided into three categories: the Globalyst 500 to 699 models represented here, which are business systems sold direct and through VARs; the Globalyst 300 to 499 models, small- or home-office machines sold retail; and the Globalyst 100 to 299 models, which are portable systems.

The AT&T Globalyst 550, 590, and 600 PCs that we tested are ISA/PCI-based machines that incorporate slots on riser cards and have integrated graphics and disk controllers. The Globalysts were all average performers on our tests, but their prices are comparatively high.

The \$2,576 AT&T Globalyst 550, based on a 486DX2/66 CPU, is a slimline PC that had no available drive bays in the unit we

tested. Graphics support is based on S3's Vision864.

The AT&T Globalyst 590 mini-tower lists for \$4,152 with a Pentium/66 and an ATI 32-bit graphics accelerator chip with 2MB of DRAM. It also has a PCMCIA card reader.

The \$5,431 AT&T Globalyst 600, with a Pentium/90, includes an ATI Graphics Pro Turbo chip with 2MB of VRAM and a 1GB SCSI hard disk.—BB

► **AT&T Global Information Solutions**, Dayton, OH; 800-225-5627, 513-445-5000.

Circle 447 on reader service card

IN SHORT

AT&T Globalyst

Business PCs with average performance at a comparatively high price.

VENDOR SERVICE & RELIABILITY (AT&T)

Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

VENDOR SERVICE & RELIABILITY (NCR)

Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE



Austin Computer Systems

• Austin Communications Manager

In its Communications Manager line, Austin Computer Systems offers high-performance, price-competitive PCs configured for data communications, fax, and voice mail. The \$2,153 Communications Manager 486DX2-66 had average scores on our tests, while the \$3,007 Communications Manager P66 was a performance leader in its class. This line's telephony capabilities and price-performance leadership make it easy to recommend.

Both Communications Manager models tested come with Sony double-speed CD-ROM drives and a Media Magic Telemetry-32 combination fax modem and sound card. The Telemetry-32 board supports wavetable synthesis and MPEG-2 audio compression/decompression. The board provides 19,200-bps fax modem capability, augmented by automatic fax, data, and voice incoming call sensing; voice mail; remote access of both

voice messages and faxes; call screening; and speaker-phone.

The 486DX2-66 posted average scores for its class across our tests. The P66 posted impressive test scores for its class, including a first-place Graphics WinMark 95 score and a second-place Winstone 95 score. Its Disk WinMark 95 score was above average.—BB

► **Austin Computer Systems**, Austin, TX; 800-438-9938, 512-339-3500; fax, 512-454-1357.

Circle 448 on reader service card

IN SHORT

Austin Communications Manager

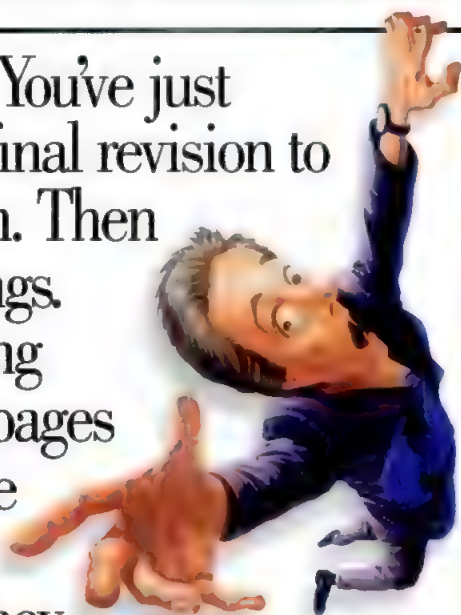
Strong performers outfitted for voice mail, fax, and data communications.

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE



It's 3:50 pm. You've just finished the final revision to the sales plan. Then the phone rings. "We're sending over 10 new pages of competitive info." Click. Good thing they lock the windows on this floor. You have to get it into the plan by the end of the day. What now?



Austin Computer Systems

● Austin Edutainer

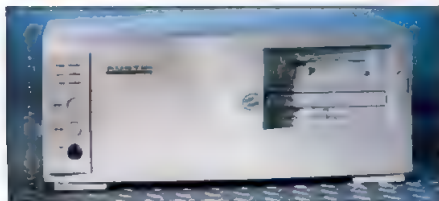
Specifically configured for the education and training markets, Austin Computer Systems' Austin Edutainer line also aims for home multimedia system buyers as a secondary market. Distinct from Austin's Power System line for mainstream business users and its Communications Manager line of home systems with extensive telecommunications features (both reviewed separately), the Edutainer models all have hardware and installed software to support MPEG-1 standard full-motion video. Each Edutainer includes a Media Magic sound card, speakers, and a Sigma Designs ReelMagic Lite MPEG decompression board. We tested two competitively priced systems in our roundup: the \$2,198 Edutainer, a 486DX2/66 PC, and the \$3,126 Edutainer Plus, a Pentium 60 unit. Performance of the two Edutainers varied on our tests.

The Edutainer uses only an ISA bus, and had an integrated Cirrus Logic graphics chip with 2MB of DRAM. It comes in a slimline case, so drive space is limited. This system attained average Winstone 95 and Disk WinMark 95 scores, and a below-average Graphics Winmark 95 score for its class.

The Edutainer Plus had a PCI Diamond Stealth 32 graphics card. This model posted an above-average Winstone score and average scores on our Disk WinMark and Graphics WinMark tests, compared with other midrange systems.—BB

► **Austin Computer Systems**, Austin, TX; 800-483-9938, 512-339-3500; fax, 512-454-1357.

Circle 448 on reader service card



Austin Computer Systems

● Austin Power System

Austin Computer Systems' Power System line is its mainstream group of systems, consisting exclusively of Pentium units. This line is not specialized for home telephony applications like Austin's Communications Manager line, or for education and training like the Edutainer group (both reviewed separately).

We tested two Power Systems: a \$2,729 60-MHz Pentium machine with a combination PCI/VL-Bus design, and a \$3,321 90-MHz Pentium model, which uses a PCI bus. Both were average performers on our tests in their respective groups, and were reasonably priced as configured. Austin also provides a three-year warranty with the Power Systems.

The Austin Power System 60 mini-tower PC comes loaded with a PCI-based Diamond Stealth 64 graphics card with 2MB of DRAM, a 540MB hard disk, a Sony double-speed CD-ROM drive, and an ISP-16 sound card. On our tests, the Austin Power 60 posted average scores compared with other midrange systems.

The Austin Power System 90, a tower PC, comes with a 1.08GB IDE hard disk, a Teac quadruple-speed CD-ROM drive, and the same graphics card and sound card as on the Austin Power 60. The Austin Power 90's benchmark test scores were average across the board compared with the other high-end units in this roundup.—BB

► **Austin Computer Systems**, Austin, TX; 800-483-9938, 512-339-3500; fax, 512-454-1357.

Circle 448 on reader service card

IN SHORT	
Austin Power System	
<i>Reasonably priced, average performers; good for home or business use.</i>	
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE



CAF Technology Inc.

● CAF Systems

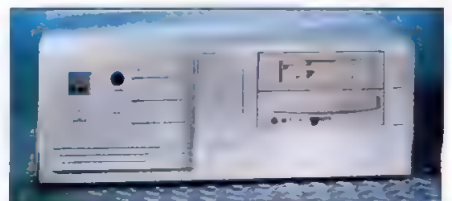
CAF Technology aims its systems at two market segments. The 486DX2/66-based CAF Gold G66 system, aimed at price-conscious and entry-level buyers, is a good deal at \$1,999. But the two Pentium units we tested—the \$2,699 CAF Lightning P6 and the \$2,999 CAF Lightning P9—are targeted toward high-end power users. (By the time you read this, CAF says it will be shipping Pentium machines based on a different motherboard.)

Despite a small-footprint case, the Gold's motherboard has two ISA slots, two VL-Bus slots, and three PCI slots. The unit includes a disk controller with 2MB of cache and a Diamond Stealth 64 graphics card (also used in the Pentium systems). The Gold managed a Winstone 95 score that was above average for its class, just below average for Disk WinMark 95, and average for Graphics Winmark 95.

Both Pentium units have three ISA slots; the Lightning P6 has three PCI and three VL-Bus, while the Lightning P9 has four PCI and two VL-Bus. Though the Lightning P6 came with a 66-MHz Pentium CPU installed, its motherboard jumper was set to run the processor at 60 MHz. The unit couldn't run our Winstone tests at the higher speed, so we report results achieved at 60 MHz. Despite that, the Lightning P6, with average test scores for its midrange class (except for a below-average Disk WinMark score), is the better overall performer of the two Pentium systems. Compared with other high-end units, the Pentium/90-based Lightning P9 posted below-average scores on every test.—BB

► **CAF Technology Inc.**, City of Industry, CA; 818-369-3690; fax, 818-369-3692.

Circle 449 on reader service card



IN SHORT	
CAF Systems	
<i>Combination ISA/VL/PCI bus systems; Pentiums are sluggish.</i>	

Compaq Computer Corp.

• Compaq Deskpro XL

Compaq's EISA/PCI-based Deskpro XL series is the company's flagship line for the corporate market. In lieu of rock-bottom prices, the \$4,598 Deskpro XL 566 Model 535/CDS and \$3,698 Deskpro XL 466 Model 535/CDS we tested combine thoughtful design, an outstanding service policy, and competitive performance, although this line does not yet include a 90-

Compaq's Deskpro XL series combines thoughtful design, an outstanding service policy, and competitive performance.

MHz Pentium PC. Compaq's other lines (not reviewed here) include the Deskpro XE for midrange corporate users, the Prolinea line for entry-level business use, and the home-oriented Presario (reviewed in this issue's First Looks section).

The 466 and the 566 feature a clean internal layout and superb design. The CPUs and SIMMs are on an upgradable proprietary card. The motherboards include built-in SCSI, hard disk, floppy disk, and I/O controllers and integrated Business Audio and Ethernet support. As a result, all four EISA slots were free, and only one of the two PCI slots was taken by

IN SHORT

Compaq Deskpro XL

Highly integrated PCs with Business Audio and exceptional support.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



Compaq's QVision 2000 graphics card. Even Compaq's Vocalyst keyboard is a testament to integration, as it incorporates a speaker, microphone, and headphone jacks.

Both the 466 and the 566 did well on our tests, garnering average Winstone 95 and Disk WinMark 95 scores for their classes. The 566 achieved an average Graphics WinMark 95 score despite a 32-bit graphics accelerator, while the 466 managed an above-average score within its class.

Compaq offers a three-year warranty and 24-hour, 7-day toll-free technical support.—AY

► **Compaq Computer Corp.,** Houston, TX; 800-345-1518; fax, 713-378-1442.

Circle 450 on reader service card

CompuAdd Computer Corp.

• CompuAdd Systems

As you climb the price and performance ladder, the \$2,413 C466D Desktop, the \$3,412 CP60p Desktop, and the \$3,503 CP90p Mini-Tower from CompuAdd Computer Corp. increase not just in

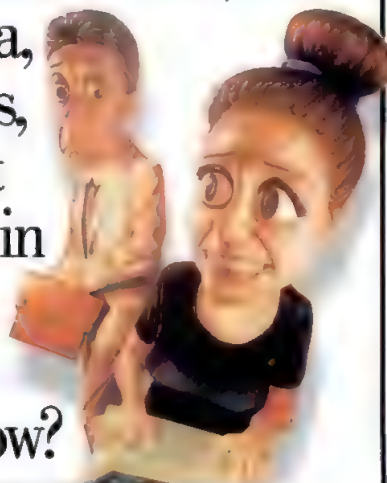
processor speed and hard disk capacity but also in case size. While the 60-MHz Pentium-based CP60p and the 90-MHz Pentium-based CP90p were average performers on our Windows-based tests in their classes, the 486DX2/66 unit's scores ranged from average to below average.

CompuAdd's entry-level unit is the C466D. This 486DX2/66 PC in a slimline case has a limited number of drive bays, with only one of four bays available in the tested system. Disk and I/O controllers are integrated. Equipped with a 424MB IDE hard disk and an integrated 32-bit ATI graphics chip with 2MB of DRAM, the C466D turned in below-average scores on our Graphics WinMark 95 and Disk WinMark 95 tests, but its Winstone 95 score was average for its class.

The CP60p, in a desktop case,



You think she's finishing the proposal. She thinks you are. Surprise, neither one of you are. And it's 4 hours before the grant committee meets. Let's see, 16 new pages of data, 11 article reviews, 3,600 words sent by your partners in Istanbul. Who can type faster? Aaargh! What now?



Pentium and 486 Buyers' Guide

IN SHORT

CompuAdd Systems

Average performers suited for general-purpose applications.

VENDOR SERVICE & RELIABILITY

Reliability **AVERAGE**

Repair service **AVERAGE**

Technical support **AVERAGE**

and Disk WinMark scores were both in the top ten of its midrange group, and its Graphics WinMark score was average.

The CP90p came with a Hercules Dynamite graphics card with 1MB of DRAM and a 1GB SCSI-2 hard disk. On our Windows-based tests, the CP90p's scores were average for its group.—BB

► **CompuAdd Computer Corp.**, Austin, TX; 800-627-1961, 512-250-1489; fax, 512-331-2862.

Circle 451 on reader service card

Comtrade

● Comtrade PCI Best Buy

Comtrade's PCI Best Buy line is targeted at the value-oriented buyer looking for a high-end entry-level PC for home or office applications. The Best Buy 486 unit has PCI and VL-Bus slots to take advantage of the latest expansion cards. We tested two systems: the \$1,995 Comtrade PCI Best Buy 466 and the \$2,595 Comtrade

IN SHORT

Comtrade PCI Best Buy

Tower systems offering strong performance for a reasonable price.



came with a 541MB IDE hard disk and Hercules Dynamite graphics card with 2MB of DRAM. This system's test scores were very competitive: Its Winstone (which was higher than the score posted by the CP90p)

and Disk WinMark scores were both in the top ten of its midrange group, and its Graphics WinMark score was average.

The CP90p came with a Hercules Dynamite graphics card with 1MB of DRAM and a 1GB SCSI-2 hard disk. On our Windows-based tests, the CP90p's scores were average for its group.—BB

► **Comtrade**, City of Industry, CA; 800-969-2123, 818-961-6688; fax, 818-369-1479.

Circle 452 on reader service card

Comtrade

● Comtrade PCI CAD/Publishing

Configured with larger disk drives, more video RAM, and larger monitors than the company's entry-level Best Buy line, Comtrade's PCI CAD/Publishing line is targeted toward CAD and desktop publishing users. The \$3,395 CAD/Publishing 566 and \$3,695 CAD/Publishing 590 were very competitive performers in their respective groups on our Windows-based tests. The Comtrade PCI CAD/Publishing PCs hit the target with good performance at reasonable prices.

Both units are equipped with double-speed CD-ROM drives, tower cases, and 2MB Diamond Stealth 64 PCI graphics cards, and both posted good benchmark test scores, particularly on our disk and graphics component tests. Based on components, expansion, performance, and price, the Comtrade PCs are a

good deal.

Comtrade targets the 466 as a low-cost system for beginners or non-demanding users. The 486DX2/66-based unit had an average score for its class on the Winstone 95 tests, and its Disk WinMark 95 and score was one of the highest in its group—as was its Graphics WinMark 95 score. The system's motherboard has one VL-Bus slot and two PCI slots.

There are no VL-Bus slots on the 66-

MHz Pentium 566 system. Comtrade has accurately positioned this unit for users who don't want a bare-bones PC, but also don't want the high price that accompanies the highest level of performance. The 566 offers three PCI and five ISA slots. Although an average performer on the Winstone tests, the 566 had an above-average Disk WinMark score and tied for first place on the Graphics WinMark tests for its group.—BB

► **Comtrade**, City of Industry, CA; 800-969-2123, 818-961-6688; fax, 818-369-1479.

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Comtrade

● Comtrade PCI CAD/Publishing

Configured with larger disk drives, more video RAM, and larger monitors than the company's entry-level Best Buy line, Comtrade's PCI CAD/Publishing line is targeted toward CAD and desktop publishing users. The \$3,395 CAD/Publishing 566 and \$3,695 CAD/Publishing 590 were very competitive performers in their respective groups on our Windows-based tests. The Comtrade PCI CAD/Publishing PCs hit the target with good performance at reasonable prices.

Comtrade targets the 466 as a low-cost system for beginners or non-demanding users. The 486DX2/66-based unit had an average score for its class on the Winstone 95 tests, and its Disk WinMark 95 and score was one of the highest in its group—as was its Graphics WinMark 95 score. The system's motherboard has one VL-Bus slot and two PCI slots.

There are no VL-Bus slots on the 66-

MHz Pentium 566 system. Comtrade has accurately positioned this unit for users who don't want a bare-bones PC, but also don't want the high price that accompanies the highest level of performance. The 566 offers three PCI and five ISA slots. Although an average performer on the Winstone tests, the 566 had an above-average Disk WinMark score and tied for first place on the Graphics WinMark tests for its group.—BB

► **Comtrade**, City of Industry, CA; 800-969-2123, 818-961-6688; fax, 818-369-1479.

Circle 452 on reader service card

The Comtrade PCI Best Buy 486 has both PCI and VL-Bus slots, and it posted high Graphics WinMark 95 and Disk WinMark 95 scores.

MHz Pentium 566 system. Comtrade has accurately positioned this unit for users who don't want a bare-bones PC, but also don't want the high price that accompanies the highest level of performance. The 566 offers three PCI and five ISA slots. Although an average performer on the Winstone tests, the 566 had an above-average Disk WinMark score and tied for first place on the Graphics WinMark tests for its group.—BB

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Circle 452 on reader service card

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Both tested systems came in eight-bay mini-tower cases. Their Intel motherboards had five ISA slots and three PCI slots, with only one slot of each type in use in the tested configurations. Each machine came with a Conner 1GB IDE hard disk and a Diamond Stealth 64 PCI graphics board with 4MB of VRAM, plus a 17-inch Mag Innovision monitor.

If you want a big drive and fast graphics but don't need the fastest processor, the 566, with a 66-MHz Pentium CPU, costs \$300 less than the top-of-the-line 590 and differs so little in performance that you might not even notice. The 566 posted an average Winstone 95 score for its class and above-average Disk WinMark 95 and Graphics WinMark 95 scores. Its Disk WinMark score was actually a bit higher than the 590's.

The 590, which except for the faster CPU is configured almost identically to its 66-MHz sibling, achieved an average Winstone score, an above-average Disk WinMark score, and a very high Graphics WinMark score for its high-end group.—BB

► **Comtrade**, City of Industry, CA; 800-969-2123, 818-961-6688; fax, 818-369-1479.

Circle 452 on reader service card

Cornell Computer Systems

● Cornell Ultima Power Workstation

Cornell's Ultima Power Workstations are geared toward high-end corporate users. The \$4,488 PCI/EISA Ultima Workstation we tested is especially well suited to compute-intensive tasks since it included a 1GB SCSI hard disk and a quadruple-speed CD-ROM drive and is upgradable to support a second Pentium CPU. Its performance across our tests was good, but Cornell's other entry, the \$3,095 PCI

IN SHORT

Comtrade PCI CAD/Publishing

Reasonably priced PCs with big monitors for CAD or DTP users.



Power Workstation, couldn't keep up with the other units in its group on our Winstone 95 tests.

Both systems came in identical tower cases and had drive bays to spare. Slots are a different story, however. The 90-MHz Pentium Ultima has four EISA and four PCI slots (including a shared slot), but the tested configuration had only one PCI slot free—the others were taken by

*The Pentium/90
Ultima offers both PCI
and EISA slots, but only
one was free in the tested
configuration.*

the graphics and hard disk controllers and by a voltage converter. The company says new power supplies are already available, so this shouldn't be a problem with new systems. The 66-MHz Pentium Power, which has a combination ISA/PCI bus, had one of its three PCI slots free.

Compared with other high-end systems, the Ultima posted an average score on our Winstone tests and had average to slightly above-average results on all remaining tests. The Power's Winstone score was below its midrange group's average, though it had average to slightly above-average results on the remaining tests.

IN SHORT

Cornell Ultima Power Workstation

These roomy tower units are geared toward high-end corporate users.



The Cornell systems come with a better-than-average warranty: three years on parts and labor, with the first year of on-site service included.—AY

► **Cornell Computer Systems**, Walnut, CA; 800-886-7200, 909-594-5848; fax, 909-594-9995.

Circle 453 on reader service card

► SUMMARY OF FEATURES

CONTINUES

Pentium and 486 PCs

List price (tested configuration) For companies that sell through dealers or resellers, street prices average 10 to 15 percent less than the list prices. Some companies factor this discount into their quoted prices; we indicate these prices as *estimated*.

Installed, maximum motherboard RAM We list the amount of RAM installed in the tested system and the maximum amount of RAM supported.

Installed, maximum external RAM cache We list the amount of processor cache installed in the tested system and the maximum amount of processor cache supported.

We indicate the **BIOS manufacturer and version (or date)** for each system. The BIOS, which performs a computer's initial boot and test routines and lets the operating system communicate with hardware, may affect a unit's performance on PC Magazine Labs' benchmark tests.

Flash BIOS replaces conventional ROM storage and can be electronically reprogrammed, making the BIOS upgradeable. A **16550 UART chip** assists in high-speed serial communications.

Graphics adapter (and memory) indicates which graphics card or chip set is used in the tested system and how much graphics memory is provided.

We indicate the model and speed of the **CD-ROM drive** on each tested system. A double-speed drive is represented as 2x, triple-speed as 3x, and so on.

We indicate whether a **modem**, a **network adapter**, or **audio** capabilities are provided in the system we tested, either built on to the motherboard or via expansion cards.

Warranty on parts, labor All vendors include at least a one-year parts-and-labor warranty with their systems.

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CIRCLE 292 ON READER SERVICE CARD

► SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company

■ = YES □ = NO

	AcerPower 486DX/86	AcerPower 60MHz Pentium	AcerPower 90MHz Pentium	ACMA Desktop 486DX/86	ACMA P90 Tower	ACMA P90 Tower	Alaris Leopard Plus EnergySmartPC 486SLC2 W	Alaris Compaq EnergySmartPC 486SLX 75
List price (tested configuration)	\$2,149	\$3,199	\$3,599	\$2,295	\$3,395	\$3,895	\$1,989	\$2,239
Processor	Intel 486DX/86	Intel Pentium/60	Intel Pentium/90	Intel 486DX/66	Intel Pentium/66	Intel Pentium/90	IBM 486SLC2/66	IBM BL 25/75
Installed/maximum motherboard RAM	8MB, 64MB	16MB, 128MB	16MB, 128MB	8MB, 64MB	16MB, 128MB	16MB, 128MB	8MB, 64MB	16MB, 64MB
Installed/maximum external RAM cache	256K, 512K	256K, 256K	256K, 256K	256K, 512K	256K, 256K	256K, 256K	512K, 512K	256K, 512K
Motherboard manufacturer	Acer	Acer	Acer	FCT	Intel	Intel	Alaris	Alaris
Chip set manufacturer	ALI	Intel	Intel	SIS	Intel	Intel	OPTi	OPTi
BIOS manufacturer and version (or date)	Acer 8/24/94	Acer 1.2R1.4	Acer 1.2R1.4	Award 4.50G	AMI 4/15/94	AMI 1.00.06.AX1	Microid 1.81	Microid 1.53
Flash BIOS/16250 UMBT chip	■ ■	■ ■	■ ■	□ □	■ ■	■ ■	■ □	□ ■
Expansion-bus slots	5 ISA, 3 PCI, 1 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 VL	5 ISA, 2 VL
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	Diamond Stealth 64 (1MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Alaris StyEagle (1MB)	Alaris StyEagle (1MB)
Hard disk capacity and interface	527MB IDE	528MB IDE	810MB IDE	503MB IDE	503MB IDE	1GB IDE	425MB IDE	503MB IDE
CD-ROM drive (and speed)	Matsushita CR-562-B (2x)	Matsushita CR-562-B (2x)	Matsushita CR-562-B (2x)	Chiron CDS-535 (2x)	Chiron CDS-535 (2x)	Chiron CDS-535 (2x)	Mitsumi FX001D (2x)	Toshiba XMA-3401B (2x)
Modem/Network adapter (Audio)	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Accessible drive bays (5.25", 3.5")	3, 2	3, 2	3, 2	3, 1	4, 2	4, 2	3, 2	5, 2
Internal drive bays (5.25", 3.5")	0, 1	0, 2	0, 2	0, 2	2, 3	2, 1	0, 0	1, 2
Power supply (and number of connectors)	145W (4)	200W (3)	200W (3)	250W (8)	250W (6)	300W (6)	200W (4)	300W (4)
Monitor (and diagonal screen size)	Acer AcerView 59L (18")	Acer AcerView 76L (17")	Acer AcerView 76L (17")	MAG Imnovation DX15F (15")	MAG Imnovation MX05F (15")	MAG Imnovation DX17F (17")	IBM 6324 (14")	IBM 6324 (14")
System software	DOS 6.22, Windows 3.1	DOS 6.22, Windows 3.11	DOS 6.22, Windows 3.1	DOS 6.22, WWG 3.11	DOS 6.22, WWG 3.11	DOS 6.22, WWG 3.11	DOS 6.22, WWG 3.11	DOS 6.22, WWG 3.11
Warranty on parts/labor	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years
On-site service	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$79 (1 year)	\$79 (1 year)

ALI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

Data Storage Marketing Inc.

• DataStor

Data Storage Marketing Inc.'s DataStor line consists of desktop and tower-case systems with all components integrated except local-bus SCSI controllers and graphics cards. Aside from a three-year warranty, the three DataStor units we tested—the \$2,889 entry-level DataStor 486-66DX2VESA, the \$3,865 ISA/PCI DataStor P5-66, and the \$4,145 PCI/ISA DataStor P5-90—had no outstanding features. Average performers at best, the DataStor line lagged behind its competitors, particularly the 486-66DX2VESA and P5-90 models.

The 486-66DX2VESA desktop had a very low score on our Winstone 95 test and average Disk WinMark 95 and Graphics WinMark 95 scores compared with its tier. It came with a SCSI hard disk and an STB LightSpeed 32-bit VL-Bus graphics board with 2MB of DRAM.

An average performer for its class, the P5-66 unit used the same graphics board as the 486-66DX2VESA model but in a

PCI version. The P5-66 posted average Graphics WinMark, Disk WinMark, and Winstone scores for its group. The system used a 1GB SCSI hard disk and had one of the most capacious cases in this review, with a total of 11 drive bays.

Though the P5-90 had the same hard disk and graphics card as the P5-66, it

IN SHORT

DataStor

Systems backed by comprehensive warranties, but laggard performers.



managed only an average Winstone score compared with its CPU group. Its Graphics WinMark score was average, but its Disk WinMark score was below average for its group.—BB

► **Data Storage Marketing Inc.,** Boulder, CO; 800-543-6098, 303-442-4747; fax, 303-442-7985.

Circle 454 on reader service card

Dell Computer Corp.

PC EDITORS' CHOICE
Dell Dimension XPS

Dell Computer Corp.'s Dimension line is targeted to small business and home office settings, where conventional, low-cost PCs are sufficient for many uses. The Dimension XPS models are somewhat better equipped than basic Dimension systems which, for example, have integrated graphics controllers compared with the XPS models' graphics boards with faster accelerator chips. All Dimensions lack more expensive features, such as ROM-embedded diagnostic software, found in the upscale Dell OptiPlex or highest-end EISA/PCI-based Dell OmniPlex lines (reviewed separately).

PCs in the Dimension XPS line



AMAX 486DX2 66 PowerSaver	AMAX 66 PowerStation	AMAX 90 PowerStation	American Multisystems InfoGold 486DX2/66	American Multisystems InfoGold Pentium/66	American Multisystems InfoGold Pentium/90	AST Bravo LC 4/66d	AST Bravo MS P/90	AST Premia MX 4/66d	AST Premia MX 4/100
\$2,049	\$3,460	\$3,999	\$1,495	\$2,500	\$4,295	\$2,263 (estimated)	\$3,189 (estimated)	\$2,880 (estimated)	\$3,770 (estimated)
Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel 486DX2/66	Intel DX4/100
8MB, 32MB	16MB, 128MB	16MB, 128MB	8MB, 64MB	16MB, 192MB	16MB, 128MB	8MB, 64MB	16MB, 128MB	8MB, 128MB	16MB, 128MB
256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 512K	256K, 256K	84K, 256K	256K, 256K	256K, 256K	256K, 256K
Impression USA	Intel	Intel	FCT SES	Asus Intel	Intel	AST VLSI	AST VLSI	AST Intel	AST Intel
AMI (8/8/93)	AMI 1.00.07.AF2	AMI 1.00.06.AX1	Award 4.50G	Award 4.5	AMI 1.00.03.AX1Z	AST Bravo 1.0	AST 1.00.26	AST 1.00.27	AST 1.00.27
□ ■	■ ■	■ ■	□ □	■ ■	■ ■	□ □	■ ■	■ ■	■ ■
6 ISA, 2 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	4 ISA, 3 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	3 ISA, 1 VL	3 ISA, 2 PCI	4 ISA, 3 PCI	4 ISA, 3 PCI
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
Diamond Stealth 64 (1MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (4MB)	Diamond Stealth 24 (1MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Integrated Cirrus Logic GD5428 (1MB)	Integrated Cirrus Logic GD5434 (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)
541MB IDE	540MB IDE	1GB IDE	494MB IDE	404MB IDE	1.7GB SCSI	404MB IDE	514MB IDE	404MB IDE	731MB IDE
Chicon	Chicon	NEC	Sony	Sony	Toshiba	Sony	Sony	Sony	Sony
CDS-535 (2x)	CDS-535 (2x)	CDR-510 (3x)	CDU 33A (2x)	CDU 33A (2x)	XM-3401B (2x)	CDU 33A (2x)	CDU 33A (2x)	CDU 55E (2x)	CDU 55E (2x)
□ □ ■	■ ■ ■	■ ■ ■	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □
2, 2	4, 0	4, 0	2, 2	3, 1	4, 0	2, 1	1, 1	2, 1	2, 2
0, 0	2, 2	2, 2	0, 2	0, 4	0, 3	0, 2	1, 1	0, 2	0, 2
250W (3)	250W (3)	300W (3)	200W (5)	300W (3)	250W (3)	145W (3)	145W (4)	230W (4)	230W (4)
Impression DCM-1588 (15")	Impression DX-17F (17")	Impression DX-17F (17")	Everware Technology DM-1448 (14")	Everware Technology DM-1448 (14")	Artec CM-156S (16")	AST Vision 5L (16")	AST Vision 5L (16")	AST Vision 5L (15")	AST Vision 5L (15")
DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, Windows 3.1	DOS 6.22, Windows 3.1	DOS 6.22, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.21, Windows 3.11	DOS 6.21, Windows 3.1	DOS 6.21, Windows 3.1
1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
\$39 (1 year)	\$39 (1 year)	\$39 (1 year)	None	None	None	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

offer ISA/VL-Bus combinations on 486 models (not reviewed) and ISA/PCI buses on Pentium systems. We tested the \$2,599 Dimension XPS P60 and the \$3,149 Dimension XPS P90 (an Editors' Choice winner). Test results were mixed, which suggests you should pick components carefully. Both Dimensions came equipped with a #9GXE64 graphics board with 2MB of DRAM, a Panasonic double-speed CD-ROM drive, and a Sound Blaster 16 card.

The P60 had one of the lowest Winstone 95 scores in its group; Disk WinMark 95 and Graphics WinMark 95 scores were average. The P90's Winstone score was above average; Disk WinMark and Graphics WinMark scores were average for its class.—BB

► **Dell Computer Corp.**, Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8320.

Circle 455 on reader service card

Dell Computer Corp.

■ Dell OmniPlex

Dell Computer Corp.'s top line, the OmniPlex, offers the three-year warranty and embedded diagnostic software found in the OptiPlex line, then further ups the ante with an EISA/PCI bus and integrated SCSI-2 interface. The OmniPlex models also come with thumbscrew case closures, a notable convenience. We tested two units for this review: the \$5,479 OmniPlex 590 and the \$4,329 OmniPlex 560. The OmniPlex line is intended for high-end desktop applications or for duty as a file server. But the OmniPlex models' poor performance in their respective tiers and their comparatively high prices make the other Dell lines better deals.

The OmniPlex systems both came in desktop cases, and were equipped with NEC triple-speed CD-ROM drives. The midrange 560 was configured with a 502MB SCSI-2 hard disk, while the 590 used a 1GB SCSI-2 hard disk. Both units had integrated video with 2MB of DRAM.

The 60-MHz Pentium-based 560 was

an average to below-average performer compared with its class, with average Winstone 95 and Disk WinMark 95 scores. The 560 also had the lowest Graphics WinMark 95 scores for its class. The 90-MHz 590 system also turned in disappointing test scores. This machine posted average Winstone and Disk WinMark scores and a decidedly below-average Graphics WinMark score for its class.—BB

► **Dell Computer Corp.**, Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8320.

Circle 455 on reader service card

IN SHORT

Dell OmniPlex

EISA/PCI machines marred by poor performance and high prices.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
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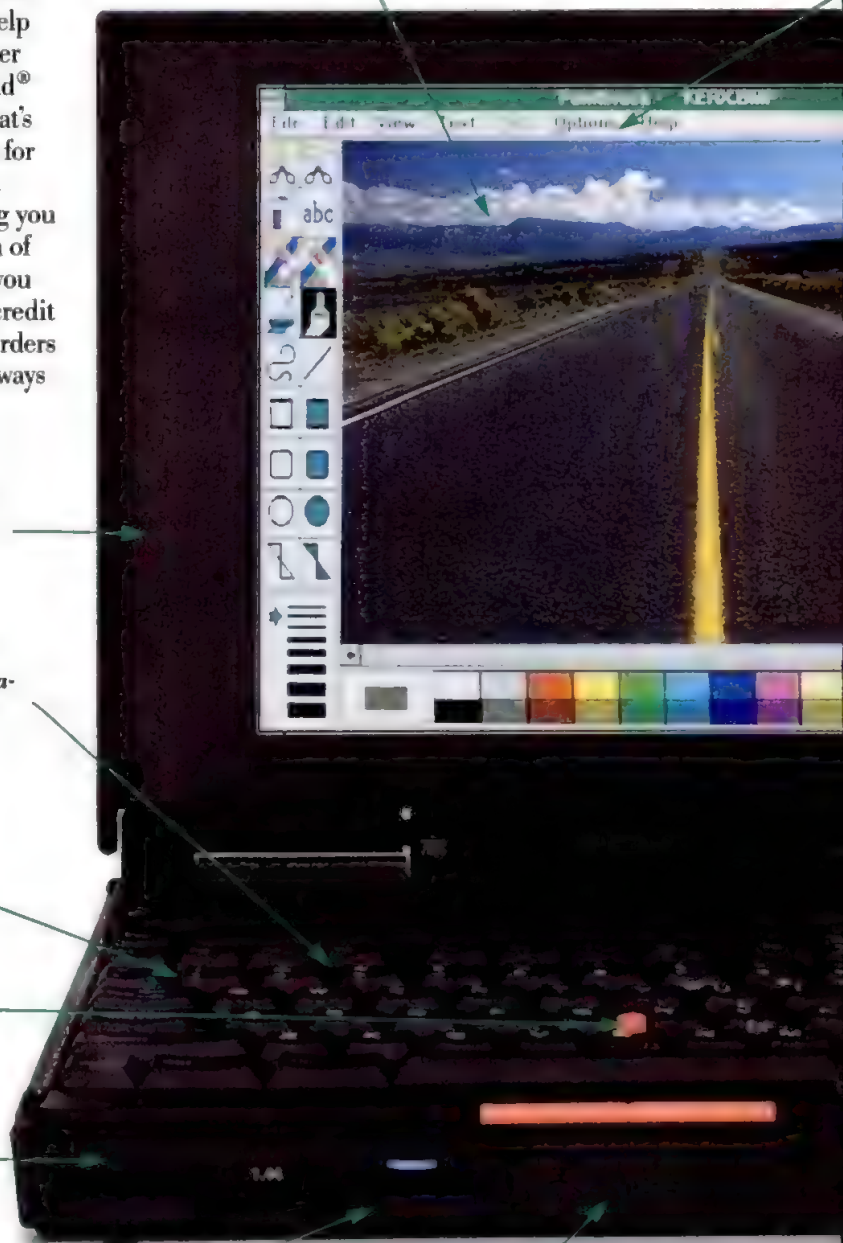
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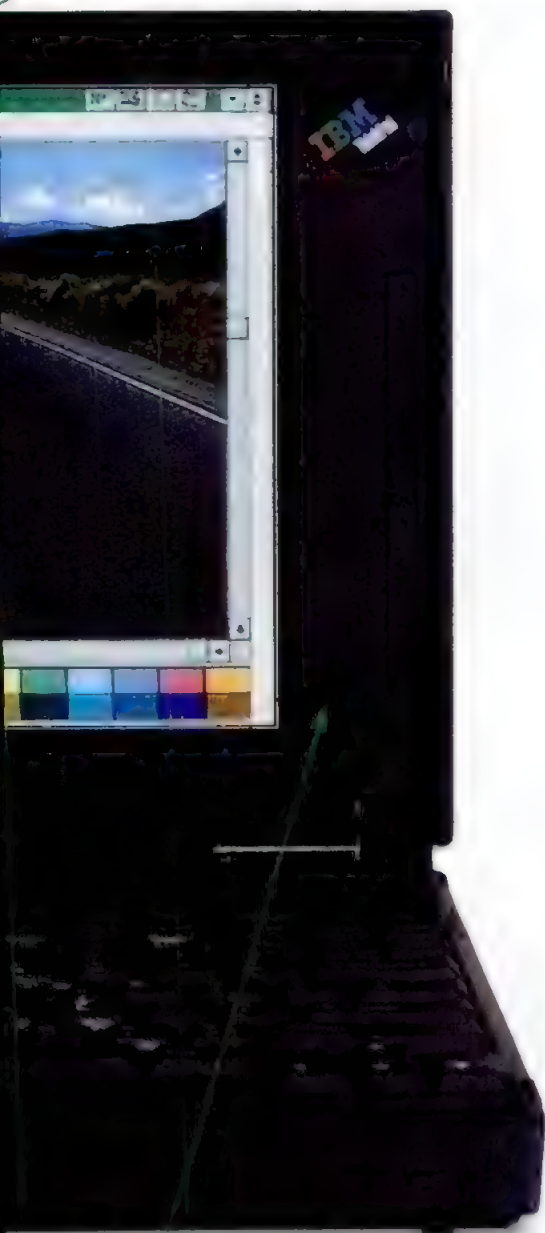
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THINKPAD 755C	THINKPAD 755Cse	THINKPAD 755CE	THINKPAD 755CD
TFT active matrix color. For more performance - Intel 486DX4/75MHz processor - Math coprocessor 16KB internal cache 4MB RAM (up to 36MB) 340MB* HD (upgradable to 810MB) Better graphics - Features a 10.4" (measured diagonally) TFT active matrix color screen - Local bus video with 1MB video memory Convenient to operate - Weights just 6.4 pounds 3.1 to 8 hrs of battery life - PCMCIA support for one Type III or two Type II or Type I devices 3.5" 1.44MB disk drive - Rechargeable NiMH battery and AC adapter - TrackPoint II on 85-key keyboard - Advanced power management features IBM extras - Hundreds of dollars worth of preloaded business software - Personalized nameplate 3-year International Traveler's Limited Warranty* - IBM EasyServ™ and 24-hour HelpCenter® with IBM Online Housecall	Dual scan color. For more performance - Intel 486DX4/100MHz processor - Math coprocessor 16KB internal cache 8MB RAM (expandable to 40MB) 340MB* HD (upgradable to 810MB) Better graphics - Features a 10.4" (measured diagonally) dual scan color screen - Local bus video with 1MB video memory Better communications - Integrated Mwave DSP provides: 14.4 data/fax modem - Mwave telephony includes telephone, full duplex speakerphone, answering machine - Full function audio support - Microphone/headphone jacks/integrated speaker - Infrared communications	Black matrix on array TFT color. For more performance - Intel 486DX4/100MHz processor - Math coprocessor 16KB internal cache 8MB RAM (expandable to 40MB) 340MB* HD (upgradable to 810MB) Better graphics - Features a 10.4" (measured diagonally) black matrix color screen - Local bus video with 1MB video memory Better communications - Integrated Mwave DSP provides: 14.4 data/fax modem - Mwave telephony includes telephone, full duplex speakerphone, answering machine - Full function audio support - Microphone/headphone jacks/integrated speaker - Infrared communications	Black matrix on array TFT color. For more performance - Intel 486DX4/100MHz processor - Math coprocessor 16KB internal cache 8MB RAM (expandable to 40MB) 540MB* HD (upgradable to 810MB) Better graphics - Features a 10.4" (measured diagonally) black matrix color screen - Local bus video with enhanced video card Better communications - Integrated DSP Mwave subsystem provides: 14.4 data/fax modem - Mwave telephony includes telephone, full duplex speakerphone, answering machine - Full function audio support - Microphone/headphone jacks/stereo speakers - Infrared communications
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ISA Token-Ring 16/4 Adapter	\$305
OS/2 LAN Server v3.0 entry with OS/2 2.11	\$615

*Memory upgrades may be manufactured in Japan, Italy, Germany, Korea, U.S.A. and/or Canada.

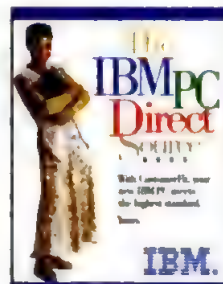
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► SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company

■ = YES □ = NO

	AST Premia GX P/90	AT&T Globalyst 550	AT&T Globalyst 590	AT&T Globalyst 600	Austin Communications Manager 486DX2-66	Austin Communications Manager P66	Austin Edutainer	Austin Edutainer Plus
List price (tested configuration)	\$5,270 (estimated)	\$2,576	\$4,152	\$5,431	\$2,153	\$3,007	\$2,198	\$3,126
Processor	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel 486DX2/66	Intel Pentium/60
Installed, maximum motherboard RAM	16MB, 192MB	8MB, 64MB	16MB, 128MB	16MB, 128MB	8MB, 128MB	16MB, 128MB	8MB, 64MB	16MB, 128MB
Installed, maximum external RAM cache	256K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	128K, 128K	256K, 256K
Motherboard manufacturer	AST	AT&T	Intel	Intel	Intel	Intel	BCM	Intel
Chip set manufacturer	Intel	OPTi	Intel	Intel	Intel	Intel	OPTi	Intel
BIOS manufacturer and version (or date)	AST Shasta 1.01	Phoenix 1.01-02	AMI 1.00.09.A	AMI 1.00.03 BF0B	AMI 1.00.02 AY0	AMI 1.00.07 AF2	Phoenix 4.03	AMI 1.00.03 AF2
Flash BIOS/16550 UART chip	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Expansion-bus slots	5 EISA, 2 PCI	3 ISA, 2 PCI	5 ISA, 2 PCI	6 ISA, 2 PCI	4 ISA, 3 PCI	4 ISA, 3 PCI	5 ISA	5 ISA, 3 PCI
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0
Graphics adapter (and memory)	ATI Graphics Pro Turbo (4MB)	Integrated S3 Vision864 (2MB)	ATI Graphics Wonder (2MB)	ATI Graphics Turbo (2MB)	Diamond Stealth 32 (2MB)	Diamond Stealth 64 (2MB)	Integrated Cirrus Logic GD5428 (2MB)	Diamond Stealth 32 (2MB)
Hard disk capacity and interface	687MB SCSI-2	341MB IDE	527MB IDE	168 SCSI-2	341MB IDE	540MB IDE	340MB IDE	514MB IDE
CD-ROM drive (and speed)	Toshiba XM-3401B (2x)	Sony CDU 561 (2x)	NEC CDR-260 (2x)	Sony CDU 561 (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Sony CDU 33A-01 (2x)	Sony CDU 33A (2x)
Modem/Network adapter/Audio	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Accessible drive bays (5.25", 3.5")	2, 1	1, 1	2, 1	2, 1	2, 0	3, 2	2, 1	2, 0
Internal drive bays (5.25", 3.5")	0, 2	0, 1	0, 4	0, 3	1, 3	1, 2	0, 1	1, 3
Power supply (and number of connectors)	230W (4)	150W (3)	200W (5)	180W (3)	200W (3)	250W (4)	200W (3)	200W (4)
Monitor (and diagonal screen size)	AST Vision SL (15")	NCR CAM630Z (15")	NCR CAM630Z (15")	NCR CAM630Z (15")	KFC MN2404 (14")	KFC MN2409 (15")	KFC MN2404 (14")	KFC MN2409 (15")
System software	DOS 6.21, Windows 3.11	DOS 6.21, WVWG 3.11	DOS 6.21, WVWG 3.11	DOS 6.21, Windows 3.11	DOS 6.21, WVWG 3.11	DOS 6.21, Windows 3.11	DOS 6.21, WVWG 3.11	DOS 6.21, WVWG 3.11
Warranty on parts/labor	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
On-site service	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

ALI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

Dell Computer Corp.

● Dell OptiPlex

The Dell OptiPlex is Dell Computer Corp.'s mainstream corporate line and comprises the bulk of its corporate sales. Intended for general business applications, the OptiPlex systems have more standard features than Dell's Dimension line, such as ROM-embedded diagnostic software on Pentium models. The OptiPlex systems come with a three-year warranty and are Energy Star-compliant.

We tested two OptiPlex models: the \$3,199 DX4/100 OptiPlex 4100/Le and the \$4,369 90-MHz Pentium OptiPlex XM590. The XM590 is based on an ISA/PCI bus design, and the 4100/Le is based on an ISA bus alone (a VL-Bus is available as an option).

The slimline 4100/Le had the second-lowest Winstone 95 score of the midrange units. This PC's small 128K Level 2 cache was a significant factor in its poor performance, as evidenced by its last-place CPUmark₁₆ score among midrange systems. The 4100/Le, with its Cirrus Logic

graphics accelerator with 1MB of DRAM, also had below-average Graphics WinMark 95 and Disk WinMark 95 scores.

The XM590 came with a 256K Level 2 cache, a 1.08GB hard disk, and an integrated S3 Vision864 graphics chip with 2MB of DRAM. The XM590 had an above-average Winstone score and average Graphics WinMark and Disk WinMark scores compared with units in its class.—BB

► **Dell Computer Corp., Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8320.**

Circle 455 on reader service card



Diamond Technologies Inc.

● Diamond Wind-Star Series

Diamond Technologies targets different market segments with the three PCs we tested. The \$2,999 Diamond Hurricane P90 is aimed at corporate buyers; the \$2,699 Diamond Tornado P66 is set for government use; and the \$1,650 Diamond Blaze 486DX2/66 is meant for home use. Pricing is attractive, but performance was mixed on our Microsoft Windows-based tests.

Within their classes, the Hurricane had an above-average Winstone 95 score and the other two units posted average scores. All three had below-average scores on our Disk WinMark 95 tests (within respective tiers); scores on our Graphics WinMark 95 tests were average. The Pentium systems had slightly above-average scores on the Graphics WinMark test. Both used Diamond Stealth video cards—the Hurricane had the 64-bit version with 2MB of VRAM, while the Tornado had the 32-bit card with 2MB of DRAM.

IN SHORT

Dell OptiPlex

Business-oriented,
Energy Star PCs
with Enhanced-
IDE support.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Austin Power System 60	Austin Power System 90	CAF Gold 666	CAF Lightning P6	CAF Lightning P9	Compaq Deskpro XL 486 Model 535/CDS	Compaq Deskpro XL 566 Model 535/CDS	CompuAdd C466D Desktop	CompuAdd CP60p Desktop	CompuAdd CP90p Mini-Tower
\$2,729	\$3,321	\$1,999	\$2,699	\$2,999	\$3,698 (estimated)	\$4,598 (estimated)	\$2,413	\$3,412	\$3,503
Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel 486DX2/66	Intel Pentium/60	Intel Pentium/90
16MB 128MB	16MB 128MB	8MB 128MB	16MB 128MB	16MB 128MB	8MB 128MB	16MB 144MB	8MB 64MB	16MB 128MB	16MB 128MB
256K 256K	256K 256K	256K 512K	512K 512K	512K 512K	256K 256K	256K 256K	256K 256K	256K 256K	256K 256K
BCM	Intel	Aquarius	TMC	Aquarius	Compaq	Compaq	Micronics	Micronics	Intel
OPTi	Intel	ALI	OPTi	OPTi	Intel	Intel	Micronics	Intel	Intel
Phoenix 4.03	AMI 1.00.05 AX1	Phoenix (4/26/94)	AMI (12/15/93)	AMI (12/15/93)	Compaq (7/19/94)	Compaq (7/19/94)	Phoenix 0.1	Phoenix 1.03	AMI 1.00.08 AX
■ ■	■ ■	■ □	■ □	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
3 ISA, 3 PCI, 2 VL	5 ISA, 3 PCI	2 ISA, 3 PCI, 2 VL	3 ISA, 3 PCI, 3 VL	3 ISA, 4 PCI, 2 VL	4 EISA, 2 PCI	4 EISA, 2 PCI	5 ISA, 1 VL	5 ISA, 3 PCI	5 ISA, 3 PCI
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0
Diamond	Diamond	Diamond	Diamond	Diamond	Compaq	Compaq	ATI Graphics	Hercules	Hercules
Stealth 64 (2MB)	Stealth 64 (2MB)	Stealth 64 (2MB)	Stealth 64 (2MB)	Stealth 64 (2MB)	QVision 2000 (2MB)	QVision 2000 (2MB)	Wonder (2MB)	Dynamite (2MB)	Dynamite (1MB)
540MB IDE	1GB IDE	546MB IDE	540MB IDE	1GB SCSI-2	536MB SCSI-2	504MB SCSI-2	424MB IDE	541MB IDE	1GB SCSI-2
Sony	Toshiba	Philips	Philips	Philips	Matsushita	Mitsumi	Mitsumi	Mitsumi	Mitsumi
CDU 33A-01 (2x)	CD 55A (4x)	LMS CR940 (2x)	LMS CR940 (2x)	LMS CR940 (2x)	CR-503 B (2x)	CR-503 B (2x)	FX001D (2x)	FX001D (2x)	FX001D (2x)
□ □ ■	□ □ ■	□ □ □	□ □ □	□ □ □	□ □ ■	□ □ ■	□ □ □	□ □ □	□ □ □
2, 2	3, 2	2, 1	3, 2	3, 2	3, 0	3, 0	2, 1	3, 2	3, 2
0, 0	1, 2	0, 2	0, 1	0, 1	0, 1	0, 1	0, 1	0, 1	0, 3
200W (3)	250W (4)	150W (5)	200W (4)	200W (4)	245W (6)	245W (6)	200W (4)	200W (3)	200W (3)
KFC MN2409 (15")	KFC MN2410 (17")	Scapire CC-615GL (15")	Scapire CC-615GL (15")	Scapire CC-615GL (15")	Compaq 171FS (15")	Compaq 171FS (15")	CompuAdd TE-664M (15")	CompuAdd TE-664M (15")	CompuAdd TE-664M (15")
DOS 6.21	DOS 6.21	DOS 6.2	DOS 6.2	DOS 6.2	DOS 6.2	DOS 6.2	DOS 6.2	DOS 6.2	DOS 6.2
WWWG 3.11	WWWG 3.11	Windows 3.1	Windows 3.11	Windows 3.11	Windows 3.1	Windows 3.1	WWWG 3.11	WWWG 3.11	WWWG 3.11
3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year
Included (1 year)	Included (1 year)	None	None	None	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

Both the Blaze and the Hurricane come in mini-tower cases; the Tornado comes in a desktop case. Both Pentium units feature ISA and PCI buses and integrated I/O; the Blaze uses a VL-Bus and ISA combination with all disk and I/O functions controlled by one VL-Bus card. The Tornado had a layout problem: The SIMMs were partially

IN SHORT

Diamond Wind-Star Series

Rock-bottom prices and good warranties, with mixed Windows performance.



blocked by a drive and prevented one of the ISA slots from using full-length cards. Systems are backed with a three-year warranty and have a guaranteed 24-hour turn-around repair time.—AY
► Diamond Technologies Inc., Anaheim, CA; 800-989-7253, 714-533-9910; fax, 714-533-7805.

Circle 456 on reader service card

Digital Equipment Corp.

• DECpc XL

The DECpc XL line is Digital Equipment Corp.'s premium line of PCs. Positioned as high-end workstations, these systems—from the \$3,813 DECpc XL 466d2 to the \$3,874 DECpc XL 566 and the \$5,522 DECpc XL 590 (prices quoted are list prices)—performed well on our Winstone 95 tests. They all offer a sufficient amount of expansion space and are easily upgradeable, but the DECpc XL line is a bit pricey compared with much of the competition.

The basic design of each system is the same: a mini-tower case with a PCI-based motherboard and graphics adapter. The systems use proprietary processor cards, starting at a 486DX2/66 card

with a standard ZIF socket and increasing to the 90-MHz Pentium card with a second ZIF socket for an additional CPU. Each unit can also accept an Alpha processor card.

Each unit posted strong Winstone scores: The 590 and the 466d2's scores were just above average for their groups. The 566 was average in its group.

Digital recently started shipping a midrange line of PCs called Celebris that combines the performance of a high-end desktop with competitive pricing (see the First Looks section of this issue for a review). List prices range from \$1,949

for a 486DX2/66 to \$2,799 for the 90-MHz Pentium model.—William P. Flanagan

► Digital Equipment Corp., Maynard, MA; 800-722-9332, 508-264-7111; fax, 800-388-3228.

Circle 457 on reader service card



IN SHORT

DECpc XL

Easy-to-upgrade PCI-based systems that perform well under Windows.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company

■ = YES □ = NO

	Comtrade PCI Best Buy 486	Comtrade PCI Best Buy 586	Comtrade PCI CAD/ Publishing 586	Comtrade PCI CAD/ Publishing 590	Cornell PCI Power Workstation	Cornell PCI/EISA Ultima Workstation	DataStar 486-660XZVESA	DataStar P5-66
List price (tested configuration)	\$1,995	\$2,595	\$3,395	\$3,695	\$3,095	\$4,498	\$2,899	\$3,865
Processor	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/66	Intel Pentium/90	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66
Installed, maximum motherboard RAM	8MB, 112MB	16MB, 128MB	16MB, 128MB	16MB, 128MB	16MB, 192MB	16MB, 192MB	8MB, 32MB	16MB, 128MB
Installed, maximum external RAM cache	256K, 256K	256K, 256K	256K, 256K	256K, 256K	512K, 512K	512K, 512K	256K, 256K	256K, 256K
Motherboard manufacturer	MicroStar	Intel	Intel	Intel	Asus	Asus	Elite Group	Intel
Chip set manufacturer	ALI	Intel	Intel	Intel	Intel	Intel	UMC	Intel
BIOS manufacturer and version (or date)	AMI (5/23/94)	AMI 1.00.07.AF2	AMI 1.00.07.AF2	AMI 1.00.07.AF2	Award 4.5	Award 4.50G	AMI (11/11/92)	AMI 1.00.07.AF2
Flesh BIOS/16550 UART chip	□□	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ ■
Expansion-bus slots	3 ISA, 3 PCI, 2 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	4 EISA, 4 PCI	4 ISA, 2 VL	5 ISA, 3 PCI
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (4MB)	Diamond Stealth 64 (4MB)	STB Powergraph Pro (2MB)	Diamond Stealth 64 (2MB)	STB LightSpeed (2MB)	STB LightSpeed (2MB)
Hard disk capacity and interface	503MB IDE	540MB IDE	1GB IDE	1GB IDE	541MB SCSI-2	1.1GB SCSI-2	345MB SCSI	1GB SCSI-2
CD-ROM drive (and speed)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	NEC CDR-510 (3x)	Plexor 4-Plex PX-43CH (4x)	Toshiba XM-3401B (2x)	Toshiba XM-3401B (2x)
Modem/Network adapter/Audio	□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□
Accessible drive bays (5.25", 3.5")	3, 2	3, 2	3, 2	3, 2	8, 0	8, 0	3, 2	8, 0
Internal drive bays (5.25", 3.5")	0, 3	0, 3	0, 3	0, 3	0, 5	0, 5	0, 0	0, 5
Power supply (and number of connectors)	230W (4)	230W (5)	230W (5)	230W (5)	300W (4)	300W (4)	250W (5)	300W (4)
Monitor (and diagonal screen size)	CTX 1562GM (15")	CTX 1562GM (15")	MAG Innovation DX-17F (17")	MAG Innovation DX-17F (17")	ADI MicroScan 4GP (15")	ADI MicroScan 4GP (15")	Viewsonic 15E (15")	Philips 78M7490741 (14")
System software	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.21, WWVG 3.11	DOS 6.21, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.21, WWVG 3.11
Warranty on parts/labor	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
On-site service	\$50 (1 year)	\$50 (1 year)	\$50 (1 year)	\$50 (1 year)	Included (1 year)	Included (1 year)	\$50 (1 year)	\$50 (1 year)

ALI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

DTK Computer Inc.

• DTK Line

DTK Computer sent two ISA/VL-Bus PCs: the \$1,900 486DX2/66-based DTK Feat-62 and the \$2,700 Pentium/66-based DTK Quin-32. Both are competitively priced with a Sound Blaster 16 MCD card and a variety of software on CD-ROM—but they cannot match other reviewed systems in performance.

The Feat came in a slimline case with all I/O, video, and hard disk controllers integrated, although DTK chose to use a Cirrus Logic-based Cardex VL-Bus graphics card instead of the on-board graphics. One bay, one VL-Bus slot, and two ISA slots (all slots are on a riser card) are free in the unit. The hard disk blocks the

two ISA slots from holding full or three-quarter-length cards. The Quin came in a roomy tower case. No slots were blocked, but as the unit is currently configured, both VL-Bus slots are taken by video and hard disk controllers. I/O is also run from the hard disk controller, and you lose an ISA slot since DTK uses its backplate for ports, leaving only two usable ISA slots.

Both units performed poorly on our tests, with below average scores for their respective classes on most tests. The only exceptions were the Feat's average results on the Winstone 95, DOS Video, and DOS

Disk tests and the Quin's average score on the CPUmark₁₆ tests.

—AY

► **DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-0098; fax, 818-810-0090.**

Circle 458 on reader service card



Duracom Computer Systems

• Duracom FilePro Line

A high level of customization is what Duracom Computer Systems believes sets it apart from other companies. Available choices range from the \$2,399 entry-level Duracom 486DX2/66 desktop to the \$3,099 midrange Duracom 586/66 mini-tower and the \$5,499 high-end Duracom FilePro 586/90 tower. Though these individual systems were not the best performers on our Microsoft Windows-based tests, Duracom will build one that can suit your needs. If you need affordable high-end performance, however, there are other units in this roundup that may hit closer to the mark.

These systems posted some of the lowest Winstone 95 scores in their respective groups. On the remainder of our Windows tests, the two Pentium systems posted average scores within their tiers. The DX2/66 unit didn't do as well, posting mostly below-average scores for its group on both Windows- and DOS-based tests.

The 486DX2/66 system included three

PC MAGAZINE
NOVEMBER 1994

DateStar PS-90	Dell Dimension XPS P60	Dell Dimension XPS P90	Dell OmniPlex 560	Dell OmniPlex 590	Dell OptiPlex 4100/Lx	Dell OptiPlex XM590	Diamond Blaze 486DX2/66	Diamond Tornado P66	Diamond Hurricane P90
\$4 145	\$2 599	\$3 149	\$4 329	\$5 479	\$3 199	\$4 369	\$1 650	\$2 699	\$2 999
Intel Pentium 90	Intel Pentium 60	Intel Pentium 90	Intel Pentium 60	Intel Pentium 90	Intel DX4 100	Intel Pentium 90	Intel 486DX2/66	Intel Pentium 66	Intel Pentium 90
16MB 128MB	16MB 128MB	16MB 128MB	16MB 192MB	16MB 192MB	16MB 64MB	16MB 128MB	8MB 64MB	16MB 128MB	16MB 128MB
256K 256K	256K 256K	256K 256K	256K 256K	256K 256K	128K 128K	256K 256K	128K 256K	256K 256K	256K 256K
Intel	Intel	Intel	Dell	Dell	Dell	Intel	Intel	Intel	Intel
Intel	Intel	Intel	Intel	Intel	VLSI	Intel	Biotech	Intel	Intel
AMI 1 00 03 AX1Z	AMI (11/11/92)	AMI (11/11/92)	Phoenix 1 00 A	Phoenix 1 00 A	Phoenix 1 10 A	Phoenix 1 1	AMI (4/4/93)	AMI 1 00 07 AF2	AMI 1 00 06 AX1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	■ ■	■ ■
5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	5 EISA, 2 PCI	5 EISA, 2 PCI	3 ISA	5 ISA, 2 PCI	4 ISA, 3 VL	5 ISA, 3 PCI	5 ISA, 3 PCI
1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0
STB LightSpeed (1MB)	Number Nine #9GXE64 (2MB)	Number Nine #9GXE64 (2MB)	Integrated ATI Mach32 (2MB)	Integrated ATI Mach32 (2MB)	Integrated Cirrus Logic GD5429 (1MB)	Integrated S3 Vision864 (2MB)	Hercules Dynamite (2MB)	Diamond Stealth 32 (2MB)	Diamond Stealth 64 (2MB)
1GB SCSI-2	527MB IDE	1GB IDE	502MB SCSI-2	1GB SCSI-2	540MB IDE	1GB IDE	502MB IDE	810MB IDE	810MB IDE
Toshiba	Matsushita	Matsushita	NEC	NEC	Matsushita	Matsushita	Mitsumi	Mitsumi	Mitsumi
XM1 3401B (2x)	CR 563 B (2x)	CR 563 B (2x)	CDR 510 (3x)	CDR 510 (3x)	CR 563 B (2x)	CR 563 B (2x)	FX001D (2x)	FX001D (2x)	FX001D (2x)
□ □ □	□ □ ■	□ □ ■	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □
6, 0	3, 0	3, 1	3, 0	3, 0	2, 0	3, 0	3, 2	3, 2	3, 2
0, 3	0, 2	0, 2	0, 1	0, 2	0, 1	0, 1	0, 2	0, 0	0, 3
300W (6)	200W (3)	200W (5)	225W (5)	225W (5)	145W (4)	150W (4)	230W (3)	230W (3)	250W (5)
ViewSonic 15E (15")	Dell UltraScan V1528U (15")	Dell UltraScan V1528U (15")	Dell UltraScan 15ES (15")	Dell UltraScan 15ES (15")	Dell UltraScan 15ES (15")	Dell UltraScan 15ES (15")	Sceptre 6Y (14")	Sceptre 6EY (14")	Sceptre 62N (14")
DOS 6.21, WinVWG 3 11	DOS 6.2, WinVWG 3 11	DOS 6.2, WinVWG 3 11	DOS 6.2, WinVWG 3 11	DOS 6.2, WinVWG 3 11	DOS 6.2, WinVWG 3 11	DOS 6.2, WinVWG 3 11	DOS 6.2, Windows 3 1	DOS 6.2, Windows 3 1	DOS 6.2, Windows 3 1
3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
\$50 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$30 (1 year)	\$30 (1 year)	\$30 (1 year)

separate controller cards: one for the CD-ROM drive; one for I/O (which also doubled as the hard disk controller); and a VL-Bus controller that inexplicably had only the floppy disk drive attached to it. This undoubtedly contributed to the system's poor disk performance. The 586/66 did not use a controller card for its disks but instead used the motherboard's integrated controller. On this system as well as on the 586/90, the design was marred by the fact that the drive cage prevented easy access to the SIMMs.—WPF

► **Duracom Computer Systems**, Irving, TX; 800-551-9000, 214-518-1200; fax, 214-518-1090.

Circle 459 on reader service card

IN SHORT
Duracom FilePro Line
Custom-built systems with deficient Windows application performance.



Dyna Micro Inc.

• Dyna System

Dyna Micro aims its Dyna Systems at corporate and business users. Pricing is competitive, but Dyna Micro failed to match the competition's performance and design with its \$3,899 Dyna System 590. The \$1,899 Dyna System 466 fared better, with fewer design limitations and an above-average Winstone 95 score for its tier.

The Dyna System 590 mini-tower offers both PCI and VESA local buses. It had five ISA slots (two with VL-Bus extensions), plus four PCI slots. Dyna Micro installed a disk and I/O controller card that takes up one of the system's ISA slots and connected the I/O ports out the back of the next ISA slot, leaving only one free. Two PCI slots were used by the graphics controller and an Adaptec SCSI controller for the CD-ROM drive. The third, an ISA/PCI slot, could not be used because of the I/O ports running out the back of the slot, and the fourth was obstructed by the CMOS battery on the motherboard. The Dyna System 466 desktop system's power

supply and drive bay casing blocked access to the SIMM banks and CPU socket, respectively.

The 466 had uneven scores on our Windows-based tests. Though its Winstone score was well above average for its tier, the Graphics WinMark 95 result was average; its Disk WinMark 95 score was well below average. The 590 turned in the lowest Winstone and Disk WinMark scores of its tier and had a below-average Graphics WinMark result. At press time, we were unable to test the unit with PC Bench 9.0.—WPF

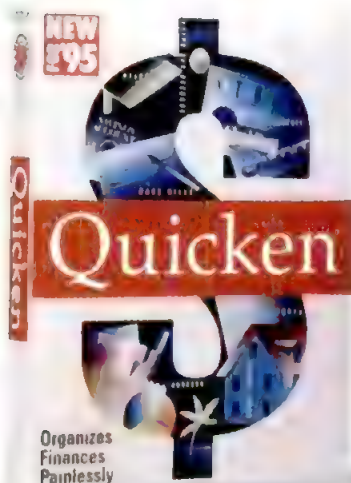
► **Dyna Micro Inc.**, San Jose, CA; 800-336-3962, 408-943-0100; fax, 408-943-0642.

Circle 460 on reader service card

IN SHORT
Dyna System
Competitively priced systems that don't stack up in terms of performance.



New 1995 Faster. Easier.



New Quicken 4 for Windows and New Quicken 8 for DOS are here.

And they're both loaded with more ways than ever to give you that confident, in-control feeling about your finances. Don't miss the best Quicken upgrade ever – with all these new features.

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Now you can automatically update your entire portfolio by modem with the latest stock, bond and mutual fund prices.

NEW! Save on taxes with Tax Planner.

Know where you stand all year long New 1995 Quicken automatically estimates your taxes from your Quicken data. It also shows the tax impact of "what-if's" like getting a raise, selling a stock or changing your withholding amounts.

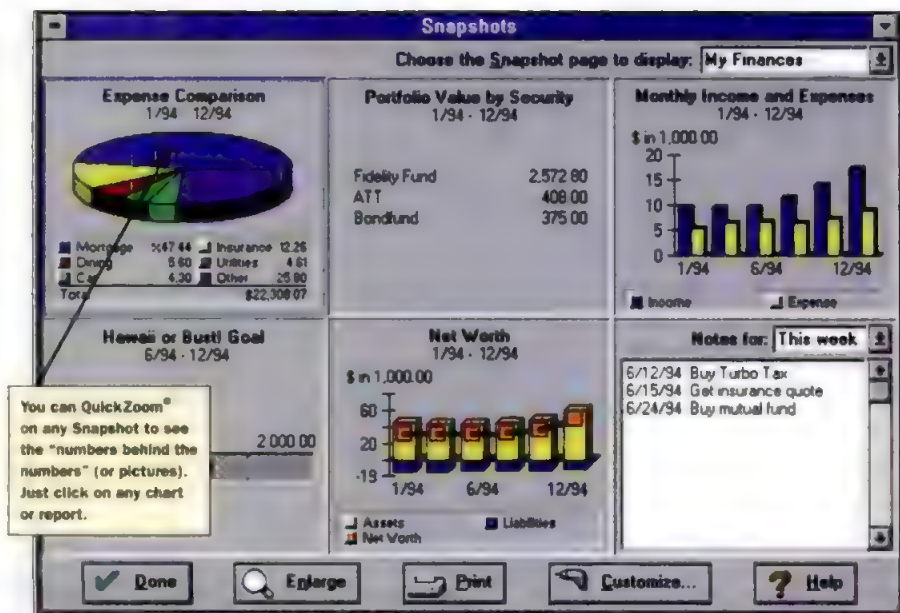
NEW! Save painlessly with Savings Goal accounts.

Now you can set aside money for a special purpose without the hassle and expense of opening a new account at the bank. Your "tucked away" savings don't show in the register! (But you can track your progress with the new Savings Progress Bars in Windows or Snapshot in DOS.)

NEW! "Smarter" budgets with Supercategories.



Simply drag and drop categories you don't want to track separately – say "dining," "entertainment" and "fitness" into a new Supercategory. New 1995 Quicken still tracks the details, but you get a top-line budget so simple it's a snap to follow. (Windows only.)



NEW! See your big picture instantly with Snapshots.

New Snapshots flashes your favorite reports and graphs on the screen all at once to give you an instant overview of your income, expenses, savings, budgets, investments and net worth for any time period. Use the preset Snapshots, or create your own in seconds – with just about any report or graph you'd want to see. (Windows and DOS Snapshots vary.)

NEW! Make smarter decisions for your future with Forecasting.

New 1995 Quicken automatically forecasts your balances and net worth based on your past spending (or budget). Then you can type in "what-if's" to see the effect on your future cash flow and net worth.



Don't miss the best Quicken upgrade ever.

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NEW! Get more done in less time with all these Windows register improvements.

Customize the register any way you like. Change the positions of the category, check date, number, memo and more to suit yourself.

Splits have never been easier. Click "v" to open. Click "x" to erase.

New Savings Progress Bar.

Date	Num	Payee	Category	Payment	Deposit	Balance
6/1/94		Hyperlane, jewelry	Hyperlane	200.00		1,049.75
6/15/94	1234	Jiff's Salary	Salary		2,184.00	8,233.00
6/18/94	Sched	State of Boston	Mortgage	1,372.00		6,861.00
6/20/94		City	Utilities	175.00		6,686.00
6/22/94		Removal (cell)	Recreation	15.00		6,671.00

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New Budget Progress Bar.

NEW! Whip through your "to-do's" with Reminders.

New 1995

Quicken gives you a fast shortcut for getting every item on your list done -

scheduled transactions, checks to print and more - right from the new Reminder screen.

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System Requirements: Quicken 8 for DOS requires 100% IBM compatible PC, 640 K RAM, DOS 3.0 or higher, 2.7 MB free on hard disk, graphics card to use graphs. Quicken 4 for Windows requires 100% IBM compatible PC, 386 or higher, Windows 3.1, 3 MB RAM minimum (4 MB RAM recommended), 8 MB free on hard disk, VGA or higher resolution monitor. Works with any printer supported by Windows 3.1. Quicken DELUXE 4 for Windows requirements same as Quicken 4 for Windows with total 12 MB free on hard disk. Quicken DELUXE 4 for Windows CD-ROM requires in addition to Deluxe requirements MPC2 compatible CD-ROM drive, sound-board and speakers; 486 or higher; MSDEX2.2 or higher; 8 MB RAM, total 24 MB free on hard disk; 256-color VGA or SVGA video; optional Hayes compatible modem.

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► SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company

■ = YES □ = NO

	DECpc XL 486-2	DECpc XL 586	DECpc XL 590	DTK Fast-62	DTK Quin-32	Duracore 486DX2/66	Duracore 586/66	Duracore FilePro 586/90
List price (tested configuration)	\$3,813	\$3,874	\$5,522	\$1,900	\$2,700	\$2,399	\$3,089	\$5,499
Processor	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90
Installed, maximum motherboard RAM	8MB, 192MB	16MB, 192MB	16MB, 192MB	8MB, 64MB	16MB, 128MB	8MB, 64MB	16MB, 128MB	16MB, 128MB
Installed, maximum external RAM cache	256K, 256K	256K, 256K	256K, 256K	128K, 256K	256K, 512K	128K, 256K	256K, 256K	256K, 256K
Motherboard manufacturer	Digital	Digital	Digital	DTK	DTK	Datatach	Intel	Intel
Chip set manufacturer	Intel	Intel	Intel	SIS	SIS	OPTi	Intel	Intel
BIOS manufacturer and version (or date)	Phoenix A44100	Phoenix 1.01	Phoenix A34956	AMI (8/8/93)	Award 4.50G	AMI 1.02.09	AMI 1.00.07 AF2	AMI 1.00.03 AX1Z
Flash BIOS/16550 UART chip	■ ■	■ ■	■ ■	□ □	□ □	■ ■	■ □	■ ■
Expansion-bus slots	4 ISA, 3 PCI	4 ISA, 3 PCI	4 ISA, 3 PCI	3 ISA, 2 VL	5 ISA, 2 VL	6 ISA, 2 VL	4 ISA, 3 PCI	5 ISA, 3 PCI
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)	Diamond Viper PCI (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (4MB)	Cardex 9208-90 (1MB)	DTK PTI-X16VESA (2MB)	Number Nine #9GXE64 (2MB)	Number Nine #9GXE64 (2MB)	Number Nine #9GXE64 (2MB)
Hard disk capacity and interface	535MB SCSI-2	535MB SCSI-2	1GB SCSI-2	380MB IDE	541MB IDE	340MB IDE	540MB IDE	1GB SCSI-2
CD-ROM drive (and speed)	Toshiba XM-4101B (2x)	Toshiba XM-4101B (2x)	Toshiba XM-4101B (2x)	Mitsumi FX001D (2x)	Matsushita CR-562-B (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Plextor DM-302B (2x)
Modem/Network adapter/Audio	□ □ □	□ □ □	□ □ □	□ □ ■	□ □ ■	□ □ □	□ □ □	□ □ □
Accessible drive bays (5.25", 3.5")	3, 1	3, 1	3, 1	2, 2	5, 0	3, 1	3, 3	4, 0
Internal drive bays (5.25", 3.5")	0, 1	0, 1	0, 1	0, 0	0, 0	0, 2	0, 0	0, 3
Power supply (and number of connectors)	300W (4)	300W (4)	300W (4)	200W (2)	200W (3)	200W (3)	220W (4)	250W (6)
Monitor (and diagonal screen size)	Digital FR-PCXSV-PE (14")	Digital FR-PCXSV-PE (14")	Digital FR-PCXAV-EA (16")	DTK DUA-1528G (15")	DTK DUA-1528G (15")	ADI MicroScan 3G (15")	ADI MicroScan 3G (15")	ADI MicroScan 4G (15")
System software	DOS 6.21, Windows 3.1	DOS 6.21, Windows 3.1	DOS 6.21, Windows 3.1	DOS 6.21, Windows 3.1	DOS 6.2, Windows 3.11	DOS 6.2, Windows 3.11	DOS 6.22, Windows 3.11	DOS 6.22, Windows 3.11
Warranty on parts/labor	3 years/3 years	3 years/3 years	3 years/3 years	2 years/2 years	2 years/2 years	1 year/1 year	1 year/1 year	1 year/1 year
On-site service	Included (1 year)	Included (1 year)	Included (1 year)	\$50 (1 year)	\$50 (1 year)	\$75 (2 years)	\$75 (2 years)	\$75 (2 years)

AU—Acar Labs Inc., AM—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FC—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

Epson Direct

• Epson Endeavor

Epson Direct aims the Endeavor line at the home, education, and business markets. Though the line's pricing is competitive enough to make these systems appealing, the Endeavor's below-average performance and lack of expandability shut it out of many environments. The \$2,313 Epson Endeavor P60 has only has one free drive bay, and the \$1,949 Epson Endeavor VL DX2/66 has no room for devices beyond those installed. Both systems performed well below their tiers' average on our Winstone 95 tests.

As in many slimline systems, the P60 has a highly integrated motherboard. An ATI Mach 32 video chip set, and disk and I/O controllers are all built in. A riser card in a proprietary slot provides three ISA and two PCI slots, one of them shared. Access to the unit's SIMM banks was blocked by the drive cage. The DX2/66 has a riser card with two VL-Bus and two ISA slots and graphics based on a Cirrus Logic VLB card.

Within their tiers, both PCs performed poorly on our Windows-based tests. The P60's Disk WinMark 95 and Graphics WinMark 95 scores were well below average for its class; its Winstone score was slightly better but still below average. The DX2/66's CPUmark₁₆ and Graphics WinMark scores were the lowest in its group (it lacked an L2 cache). Disk WinMark and Winstone scores were also below average.—WPF

► **Epson Direct,** Torrance, CA; 800-374-7300, 310-782-5478; fax, 310-782-4455.

Circle 461 on reader service card



IN SHORT

Epson Endeavor

Poor performance and lack of expandability offset these PCs' low prices.

VENDOR SERVICE & RELIABILITY

Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

EPS Technologies Inc.

• The Dominator Series

EPS Technologies offers a high-performance line with some of the best prices around. We tested its \$2,895 EPS P90 Predator, \$2,495 EPS P60 Phantom, and \$1,995 EPS 4-DX2/66 Media-Pro, all with combination ISA/PCI buses. With a three-year warranty and a 60-day money back guarantee, these systems are worth a serious look.

EPS sells mostly to the government, but it also targets corporate and home users. To better reach that latter market, EPS is now bundling a home-oriented software package with the machine.

The EPS Pentium systems did very well on our Winstone 95 tests. The Predator had above-average scores among high-end units, while the Phantom produced one of the highest Winstone scores among midrange systems—a score that bested those of many Pentium/90 and Pentium/66 systems as well. The Media-Pro managed an average score within its class. The Predator also got slightly

Dyna System 466	Dyna System 590	Epson Endeavor VL DX2/66	Epson Endeavor P60	EPS 4-DX2/66 Media-Pro	EPS P60 Phantom	EPS P90 Predator	Gain Master DX2/66	Gain Master P560	Gateway 2000 4DX2-66 Family PC
\$1,899	\$3,999	\$1,949	\$2,313	\$1,995	\$2,495	\$2,895	\$3,295	\$5,875	\$1,849
Intel 486DX2/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel 486DX2/66	Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel 486DX2/66
8MB, 64MB	16MB, 128MB	8MB, 40MB	16MB, 128MB	8MB, 128MB	16MB, 192MB	16MB, 512MB	8MB, 128MB	16MB, 192MB	8MB, 32MB
256K, 1MB	512K, 2MB	None, 256K	256K, 256K	256K, 512K	512K, 512K	512K, 512K	256K, 256K	256K, 512K	128K, 256K
Addonics	Shuttle	Epson	Intel	GBT	GBT	GBT	AMI	AMI	TI
SIS	OPTi	SIS	Intel	Intel	Intel	Intel	SIS	Intel	VLSI
Award 4.50G	Award (6/27/94)	AMI (11/2/92)	AMI 1.00.07.A	AMI 2.1	Award 4.50G	Award 4.50G	AMI (12/15/93)	AMI (12/15/93)	Phoenix 1.00.06.ACO
□□	■	□□	■	□■	□■	■	■	■□	□□
5 ISA, 2 VL	3 ISA, 4 PCI, 2 VL	2 ISA, 2 VL	3 ISA, 2 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	5 ISA, 2 VL	4 ISA, 3 PCI	5 ISA
1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
Cardex Cobra (2MB)	Diamond Stealth 64 (2MB)	Canus Logic (1.44/5.25) (1MB)	ATI Graphics Wonder (1MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (4MB)	AMI Fast View VLB (2MB)	Diamond Stealth 64 (2MB)	Integrated Cirrus Logic GD5428 (1MB)
426MB IDE	1GB SCSI-2	426MB IDE	527MB IDE	425MB IDE	528MB IDE	528MB IDE	527MB IDE	1.8GB SCSI-2	425MB IDE
Sony CDU 33A-01 (2x)	Plexor DM 302B (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Toshiba XM 3401B (2x)	Toshiba XM 3401B (2x)	Philips LMS CM206 (2x)
□□□	□□□	□□□	□□□	□□■	□□□	□□□	□■□	□□□	■□■
3, 1	3, 2	2, 0	2, 1	2, 2	2, 2	2, 2	3, 2	4, 0	2, 1
0, 1	0, 1	0, 1	0, 1	2, 0	2, 0	2, 0	0, 2	4, 0	0, 1
200W (5)	200W (3)	145W (4)	145W (4)	200W (3)	200W (3)	200W (3)	250W (3)	300W (4)	145W (5)
Addonics 152GLR (15")	Addonics 172GLR (17")	Epson CG1428N (14")	Epson T1189U (15")	ADI SM5515CP (15")	ADI SM5515CP (15")	ADI SM5515CP (15")	IDEK 8617 Vision Master (17")	IDEK 8617 Vision Master (17")	Gateway 2000 CrystalScan 14SVGA (14")
DOS 6.22, Windows 3.1	DOS 6.22, Windows 3.1	DOS 6.21, Windows 3.1	DOS 6.21, Windows 3.1	DOS 6.21, Win/WG 3.11	DOS 6.21, Win/WG 3.11	DOS 6.21, Win/WG 3.11	DOS 6.22, Win/WG 3.11	DOS 6.22, Win/WG 3.11	DOS 6.22, Win/WG 3.11
1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	3 years/1 year
\$49 (1 year)	\$4 (1 year)	included (1 year)	included (1 year)	included (1 year)	included (1 year)	included (1 year)	included (1 year)	included (1 year)	included (1 year)

above-average scores among high-end systems on most of the rest of our tests. The Phantom posted average scores among midrange systems, while the Media-Pro posted average to above-average scores in its class.

Though none of the PCs have a shortage of drive bays, some slots are used because

IN SHORT

The Dominator Series

These PCs offer the best of both worlds: strong performance for a low price.



I/O isn't integrated. On all three systems, one ISA slot is used by an I/O controller card; EPS also runs some of the ports out the backplate of a neighboring ISA slot in the Phantom and Media-Pro.—AY

► **EPS Technologies Inc.,** Jefferson, SD; 800-447-0921, 605-966-5586; fax, 605-966-5482.

Circle 462 on reader service card

Gain Systems Inc.

• The Master Series

In its Master Series, Gain Systems offers a tower system—the \$5,875 Gain Master P560—and a desktop system, the \$3,295 Gain Master DX2/66. Both systems are aimed primarily at the corporate market; both are pricey but well-designed, and both perform competitively in their respective tiers.

The P560 has eight drive bays, all of which are 5.25-inch except one made specifically for a 3.5-inch floppy disk drive. The PCI-based motherboard integrates IDE hard disk and floppy disk controllers, but Gain chose to use only the floppy disk drive controller. The 1.8GB Seagate hard disk and CD-ROM drive were handled by a QLogic SCSI card.

The DX2/66 has a desktop case with one internal drive bay that unclips to facilitate disk installations; it thereby also provides easier access to the motherboard's components. The hard disk and floppy disk drive were hooked up to the motherboard's integrated controllers, and one of the five ISA

slots was used for the CD-ROM drive's SCSI controller. A Weitek P9000-based graphics card was installed in one of the unit's two VL-Bus slots.

Relative to its performance group, the DX2/66 posted above average and average scores on our Disk WinMark 95 and Winstone 95 tests, respectively. The P560 garnered an average score on the Disk WinMark tests. The unit's Winstone score was slightly below average. On the remainder of our tests, both Gain Master systems were consistently average.—WPF

► **Gain Systems Inc.,** Norcross, GA; 800-849-4246, 404-446-2026; fax, 404-446-2028.

Circle 463 on reader service card

IN SHORT

The Master Series

Business systems with good performance but a higher-than-average price.



► SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company	Gateway 2000 P5-60 Family PC	Gateway 2000 P5-90 Family PC	Gateway 2000 P4D-66	Gateway 2000 P5-60	Gateway 2000 P5-90 XL	Hertz 486DX2/66	Hertz P866	Hertz P90
■ = YES □ = NO								
List price (tested configuration)	\$2,424	\$2,774	\$1,924	\$2,524	\$3,699	\$1,951	\$2,895	\$3,795
Processor	Intel Pentium/80	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/86	Intel Pentium/90
Installed, maximum motherboard RAM	16MB, 128MB	16MB, 128MB	8MB, 128MB	16MB, 128MB	16MB, 128MB	8MB, 32MB	16MB, 128MB	16MB, 128MB
Installed, maximum external RAM cache	256K, 256K	256K, 256K	128K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 512K	256K, 512K
Motherboard manufacturer	Intel	Intel	Intel	Intel	Intel	Hertz	Super Micro	Super Micro
Chip set manufacturer	Intel	Intel	Intel	Intel	Intel	SIS	OPTI	OPTI
BIOS manufacturer and version (or date)	AMI 1.00.08.AF2	Phoenix 1.00.09.AX1	Phoenix 4.03	AMI 1.00.08.AF2	AMI 1.00.09.AX1	AMI 4/4/93	AMI AB5960722	AMI (12/15/93)
Flash BIOS/16550 UART chip	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	■ ■	■ ■
Expansion-bus slots	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 2 VL	5 ISA, 4 PCI, 2 VL	3 ISA, 4 PCI, 2 VL
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)	STB LightSpeed (1MB)	STB LightSpeed (2MB)	STB LightSpeed (1MB)	STB LightSpeed (1MB)	ATI Graphics Pro Turbo (2MB)	Cirrus Logic GD5426-based (1MB)	Diamond Viper PCI (2MB)	Diamond Viper PCI (2MB)
Hard disk capacity and interface	539MB IDE	731MB IDE	730MB IDE	514MB IDE	1GB IDE	452MB IDE	645MB SCSI-2	1GB IDE
CD-ROM drive (and speed)	Philips LMS CM206 (2x)	Philips LMS CM206 (2x)	NEC CDR-260 (2x)	NEC CDR-260 (2x)	NEC CDR-260 (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	NEC CDR-510 (3x)
Modem/Network adapter/Audio	■ ■ ■	■ ■ ■	□ □ □	□ □ □	□ □ ■	□ □ ■	□ □ ■	□ □ ■
Accessible drive bays (5.25", 3.5")	3, 1	3, 1	3, 1	3, 1	4, 1	3, 2	3, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 3	0, 3	0, 3	0, 3	0, 4	0, 1	0, 1	0, 1
Power supply (and number of connectors)	145W (5)	145W (5)	145W (5)	145W (5)	200W (4)	200W (4)	200W (5)	200W (3)
Monitor (and diagonal screen size)	Gateway 2000 CrystalScan 1572DG (15")	Gateway 2000 CrystalScan 1572FS (15")	Gateway 2000 CrystalScan 1572DG (15")	Gateway 2000 CrystalScan 1572DG (15")	Gateway 2000 CrystalScan CS1776LE (17")	MAG Innovision DX15F (15")	MAG Innovision DX15F (15")	MAG Innovision MX15F (15")
System software	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11	DOS 6.22, WFWG 3.11
Warranty on parts/labor	3 years/1 year	3 years/1 year	3 years/1 year	3 years/1 year	3 years/1 year	1 year/1 year	1 year/1 year	1 year/1 year
On-site service	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$495 (1 year)	\$495 (1 year)	\$495 (1 year)

ALI—Acer Labs Inc. AMI—American Megatrends Inc. BCM—BCM Advanced Research Inc. C&T—Chips & Technologies Inc. ECS—Elsitgroup Computer Systems Inc. FCI—Free Computer Inc. GBT—Giga-Byte Technology, HP—Hewlett-Packard Co. SIS—Silicon Integrated Systems Corp. TI—Texas Instruments Inc. TMC—TMC Research, UMC—United Microelectronics Corp. USA—USA Integration, VLSI—VLSI Technology Inc.

Gateway 2000 Inc.

● Gateway 2000 Family PC

Gateway 2000 offers its Family PC line for home users interested in everything from on-line services to multimedia. The Pentium-based systems we tested are affordable (\$2,424 for the Gateway 2000 P5-60 Family PC and \$2,774 for the Gateway 2000 P5-90 Family PC), and combine good design with expandability; their performance results varied. The \$1,849 entry-level Gateway 2000 4DX2-66 Family PC is less inspiring: It comes in a slimline case, and posted a below-average score on our Winstone 95 tests.

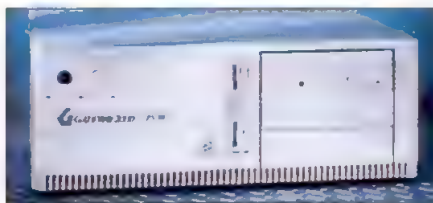
The systems come with a double-speed CD-ROM drive, a 16-bit sound card, speakers, and a modem (14.4-Kbps fax for the Pentiums; 2,400/

9,600-bps data/fax for the 4DX2-66). The Family PCs also come with a number of education- and entertainment-oriented CD-ROM titles. These options differentiate these PCs from Gateway's Professional System line, reviewed separately.

The Pentium systems use a PCI-based motherboard; the 4DX2-66 lacks any local-bus expansion slots. On our tests, the P5-90's results were all average, except for below-average scores on our Graphics WinMark 95 and Winstone tests. Among midrange systems, the P5-60's scores were average. The 4DX2-66's Winstone score was below average, and many other scores were slightly below average, for its tier.—WPF

► **Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.**

Circle 464 on reader service card



Gateway 2000 Inc.

● Gateway 2000 Professional System

Gateway 2000's Professional System line of systems is geared toward the business user, in contrast to the Family PC line which is intended for home users. With the exception of the Gateway 2000 P5-90 XL, the units in the Professional System line do not include multimedia-oriented extras like sound cards and speakers. All three Professionals are affordably priced: The P5-90 is priced at \$3,699 (which includes a 16-bit sound card and speakers); the Gateway 2000 P5-60 costs \$2,524; and the Gateway 2000 P4D-66 costs \$1,924. These units also offer competitive performance.

All Professional systems use an ISA/PCI bus design (Gateway is no longer selling VL-Bus-based PCs). The P5-60 and the P4D-66 come in identical desktop cases, which provide a surprising amount of expansion space. The P5-90 comes in a tower case.

The P5-90 did well on our tests, with av-

IN SHORT

Gateway 2000 Family PC

Affordable home-oriented PCs with extras like CD-ROM software.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

HP Vectra VL2 466	HP Vectra XU 5/90C	HiO Neptune II P66/PCI	HiO Neptune II P90/PCI	IBM ValuePoint 466DX2/Sp	IBM ValuePoint 100DX4/Op	ITI DX2-66	ITI M54PI-90	Insight 486DX2-66 MM	Insight PCI P66 MM
\$2,566 (estimated)	\$5,525 (estimated)	\$2,699	\$3,449	\$3,374	\$4,504	\$1,695	\$3,725	\$1,999	\$3,999
Intel 486DX2/66	Intel Pentium/90	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel DX4/100	Intel 486DX2/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66
8MB 64MB	16MB 256MB	16MB 128MB	16MB 128MB	8MB 128MB	16MB 128MB	8MB 64MB	16MB 192MB	8MB 96MB	16MB 128MB
256K, 256K	512K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 512K	128K, 256K	256K, 256K
HP	HP	Intel	Intel	IBM	IBM	Micronics	Micronics	FC	Intel
VLSI	Intel	Intel	Intel	OPTi	OPTi	Micronics	Intel	VIA	Intel
HP CA 04 01	HP GC 05 03	AMI 1 00 07 AF2	AMI 1 00 06 AX1	IBM SurePath 0 02	IBM SurePath 0 02	Phoenix 0 1	Phoenix (5/15/94)	Award 3 03	AMI 1 00 07 AF2
4 ISA	4 ISA 2 PCI	5 ISA 3 PCI	4 ISA 3 PCI	2 ISA, 1 VL	4 ISA, 1 VL	5 ISA, 2 VL	5 ISA, 3 PCI	5 ISA, 2 VL	5 ISA, 3 PCI
1, 2, 1	1, 1, 1	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 3, 0	1, 2, 0
Integrated	Matrox MGA	Diamond	Diamond	Integrated S3	Integrated S3	Diamond	Diamond Viper	Boca Research	Diamond
Cirrus Logic	Ultima Plus	Stealth 64 (2MB)	Stealth 64 (2MB)	Vision864 (2MB)	Vision864 (2MB)	Speedstar	PCI (2MB)	VGAXL1M (1MB)	Stealth 64 (4MB)
GD5428 (1MB)						Pro (1MB)			
341MB IDE	1GB SCSI-2	520MB IDE	1GB IDE	365MB IDE	540MB IDE	342MB IDE	810MB SCSI-2	425MB IDE	526MB IDE
HP	Toshiba	Matsushita	Matsushita	Matsushita	Matsushita	Matsushita	NEC	Sony	Matsushita
D2886 60001 (2x)	XM 4101B (2x)	CR 562 B (2x)	CR 563 B (2x)	CR 563 B (2x)	CR 563 BB2 (2x)	CR 563 B (2x)	MultiSpin 3x (3x)	CDU 33A (2x)	CR 563 B (2x)
□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □	□ □ □ □
1, 1	2, 1	3, 2	4, 0	1, 1	2, 1	3, 2	3, 2	3, 2	4, 1
0, 2	0, 1	0, 2	0, 3	0, 1	0, 1	0, 2	0, 2	0, 0	0, 8
100W (4)	160W (4)	200W (3)	250W (4)	100W (5)	205W (6)	200W (4)	200W (4)	230W (4)	230W (7)
HP D2804A	HP D2807A	ADI MicroScan	ADI MicroScan	IBM 9527 (17")	IBM 9527 (17")	Standard	NEC	CTX 1562GM	MAG
(14")	(17")	3GP (14")	3GP (14")			Technologies	JC-1535VMA	(15")	Innovation
						428C-Vesa (14")	DOS 6.2	DOS 6.21	DOS 6.21
DOS 6.2	DOS 6.2	DOS 6.2	DOS 6.22	IBM PC DOS	IBM PC DOS	DOS 6.22	Windows 3.1	Windows 3.1	Windows 3.1
WWVG 3.11	WWVG 3.11	WWVG 3.11	WWVG 3.11	6.3, WWVG 3.11	6.3, WWVG 3.11	WWVG 3.11	WWVG 3.11	WWVG 3.11	WWVG 3.11
3 years/3 years	3 years/3 years	1 year/2 years	1 year/2 years	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year
Included (1 year)	Included (1 year)	None	None	Included (1 year)	Included (1 year)	None	None	None	None

erage scores across the board compared with other high-end units. The P5-60 turned in average scores for its tier on our Windows-based tests. The P4D-66, using a PCI-based video and Enhanced IDE hard disk, produced consistently average benchmark test scores for entry-level systems, except for a below-average Disk WinMark 95 score.—WPF

► **Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.**

Circle 464 on reader service card

IN SHORT
Gateway 2000 Professional System

Well-priced, no-nonsense business units with strong performance.

VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



Hertz Computer Corp.

• Hertz Z-Optima Line

You won't find too many Hertz Computer Corp. systems in homes across America simply because Hertz does not look to the home market to sell its PCs. Instead, it targets companies, educational institutions, and government agencies. The Hertz Z-Optima Line of PCs tested in this review fit that niche well: They are affordable and solidly built, with performance that was generally below-average for their processor groups. We tested the Hertz 486D66X2e, priced at \$1,951; the Pentium/66-based Hertz P66e, which costs \$2,895; and the Pentium/90-based Hertz P9e, which sells for \$3,795.

In addition to the five front-accessible drive bays in each system's desktop case, there is one internal drive bay that snaps out easily to allow quick installation of a hard disk. This setup also provides

IN SHORT
Hertz Z-Optima Line

Solidly built units for businesses, but can't match others' performance.

clear access to components. The two Pentium systems use a PCI/VL-Bus-based motherboard, while the 486D66X2e has a VL-Bus-based motherboard.

Of the three systems, the 486D66X2e posted the most competitive numbers for its class on our Winstone 95 tests—its score was average. The two Pentium systems were among the worst performers on the Winstone tests in their respective groups. On the other Windows-based tests, the story was much the same, with the two Pentium systems posting below-average scores. The 486D66X2e had a average score for its class on the Graphics WinMark 95 tests, and a below-average score on the Disk WinMark 95 tests.—WPF

► **Hertz Computer Corp., New York, NY; 800-232-8737, 212-684-4141; fax, 212-684-3658.**

Circle 465 on reader service card



► SUMMARY OF FEATURES

Pentium and 486 PCs

PC MAGAZINE
AUGUST 1994

In alphabetical order by company

■ = YES □ = NO

	Insight PCI P90 MM	Micro Express MicroFLEX-VL/66	Micro Express MicroFLEX-VL/P66	Micron 486PCI Magnum	Micron 4100PCI Magnum	Micron P90PCI PowerStation	MicroTech Ultima XVC/66	MicroTech Ultima MP5/90
List price (tested configuration)	\$4,799	\$1,649	\$3,399	\$2,149	\$2,928	\$3,527	\$2,495	\$5,195
Processor	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel 486DX2/66	Intel DX4/100	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/90
Installed, maximum motherboard RAM	16MB, 128MB	8MB, 128MB	16MB, 128MB	8MB, 128MB	16MB, 128MB	16MB, 192MB	8MB, 64MB	16MB, 192MB
Installed, maximum external RAM cache	256K, 256K	256K, 512K	512K, 512K	256K, 256K	256K, 256K	512K, 512K	256K, 256K	256K, 512K
Motherboard manufacturer	Intel	Micro Express	Micro Express	Micronics	Micronics	Micronics	Micronics	Micronics
Chip set manufacturer	Intel	SIS	OPTi	Intel	Intel	Intel	Micronics	Intel
BIOS manufacturer and version (or date)	AMI 1.00.08.AX1	AMI (8/8/93)	AMI (12/17/93)	Phoenix 1.03	Phoenix 1.03	Phoenix (7/21/94)	Phoenix 0.1	Phoenix 4.03
Flash BIOS/16550 UART chip	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Expansion-bus slots	5 ISA, 3 PCI	5 ISA, 3 VL	5 ISA, 3 VL	6 ISA, 3 PCI	6 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 2 VL	5 ISA, 3 PCI
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)	Diamond Stealth 64 (4MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Speedstar Pro (1MB)	ATI Graphics Pro Turbo (2MB)
Hard disk capacity and interface	168 IDE	341MB IDE	341MB SCSI-2	527MB IDE	527MB IDE	168 IDE	324MB IDE	198 SCSI-2
CD-ROM drive (and speed)	Plextor 4-Plex PX-43CH (4x)	Sony CDU 33A (2x)	Toshiba XM-3401B (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Sony CDU 33A (2x)	NEC MultiSpin 3X (3x)
Modem/Network adapter/Audio	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Accessible drive bays (5.25", 3.5")	4, 1	3, 2	3, 2	3, 0	3, 0	3, 0	4, 0	4, 0
Internal drive bays (5.25", 3.5")	0, 8	0, 2	0, 2	0, 3	0, 3	0, 3	2, 2	2, 2
Power supply (and number of connectors)	230W (7)	250W (4)	250W (4)	200W (4)	200W (4)	200W (4)	250W (4)	250W (4)
Monitor (and diagonal screen size)	ViewSonic 17 (17")	Micro Express FM590 (15")	Micro Express FM590 (15")	MAG Innovation DX15F (15")	MAG Innovation DX15F (15")	MAG Innovation DX15F (15")	Synco CM-15GS (15")	Synco CM-17GS (17")
System software	DOS 6.21, WWVG 3.11	DOS 6.21, Windows 3.1	DOS 6.21, Windows 3.1	DOS 6.21, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.21, WWVG 3.11	DOS 6.21, WWVG 3.11
Warranty on parts/labor	1 year/1 year	2 years/2 years	2 years/2 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year
On-site service	None	\$50 (1 year)	\$50 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	None	None

ALI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

Hewlett-Packard Co.

● HP Vectra

Hewlett-Packard aims its Vectras mainly at corporate users. The \$2,566 (estimated street price) HP Vectra VL2 4/66 is a desktop PC offering good performance and one of the most modular designs in this roundup. The top-of-the-line HP Vectra XU 5/90C costs \$5,525 (estimated street price). It offers integrated SCSI and networking support, and it also complies with MP Specification 1.1 to support a second Pentium CPU. The attention to detail in the design of these systems, more than their performance, puts them in a class by themselves.

On two recent occasions we have awarded Editors' Choice honors to the XU 5/90C for its impressive design and performance. But this time, hobbled by a SCSI-2-based hard disk subsystem, the machine's Winstone 95 score was only average for Pentium/90 systems. Still, the XU 5/90C offers a PCI expansion bus and a high-end Matrox graphics board that helped generate fair numbers on our

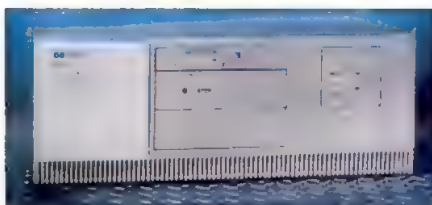
Graphics WinMark 95 tests.

The VL2 4/66's motherboard integrates the video chip set as well as I/O, hard disk, and floppy disk controllers, but it has no local bus. The system was a middling performer on our Winstone tests compared with other entry-level systems.

Hewlett-Packard offers other Vectra systems, including the Vectra N2 and Vectra M2 (not reviewed), which are designed for the networked user.—WPF

► **Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 303-635-1000.**

Circle 466 on reader service card



HiQ Computer Systems

● HiQ Neptune II

HiQ Computer Systems aims the Neptune II line at the midrange file server and high-end user markets. We tested two competitively priced HiQ Neptune II systems: the HiQ Neptune II P90/PCI (\$3,449) and the HiQ Neptune II P66/PCI (\$2,699). On our Windows-based benchmark tests, the P90/PCI generally performed well compared with others in its tier, while the performance of the P66/PCI tended to be more uneven.

The P66/PCI has a PCI-based motherboard with three PCI slots. The case is equipped with seven drive bays, the same number available with the 90-MHz tower unit. On our Windows-based benchmark tests, the P90/PCI performed consistently well, with a slightly above-average Graphics WinMark 95 score (due in part to the PCI-based Diamond Stealth graphics accelerator, which used the S3 Vision 964 chip set) and a solidly above-average Disk WinMark 95 score. On the Winstone 95 tests the unit also posted average numbers.

IN SHORT

HP Vectra

Well-designed, high-end workstations offering integrated networking.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

MidWest Micro Elite DX2-66 PCI	MidWest Micro Elite P5-66	MidWest Micro Elite P5-90	Mitsuba i486DX2-66	Mitsuba i486DX4-100	Mitsuba Fileserver-P-90	NMC Pro- System 466	NMC Expert- System P66	NMC Expert- Server+ DP90	NEC PowerMate 466D
\$1,899	\$2,599	\$3,860	\$1,699	\$3,195	\$2,950	\$1,958	\$3,297	\$4,634	\$1,754 (estimated)
Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel DX4/100	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66
8MB 128MB	16MB 128MB	16MB 128MB	8MB 64MB	16MB 64MB	16MB 128MB	8MB 95MB	16MB 192MB	16MB 192MB	8MB 128MB
256K 512K	256K 256K	256K 256K	256K 256K	256K 256K	256K 256K	256K 512K	256K 256K	256K 512K	256K 256K
Elite Group	Intel	Intel	Mitsuba	Mitsuba	Intel	Elite Group	Elite Group	Asus	NEC
Intel	Intel	Intel	OPTi	OPTi	Intel	Ali	Intel	Intel	CS1
Phoenix 403	AMI 100 07 AF2	AMI 100 06 AX1	AMI (6/1/94)	AMI (6/1/94)	AMI (6/16/94)	Phoenix (4/26/94)	Award (4/21/94)	Award 4.5	Phoenix 403
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	□ □ □	□ ■ ■	■ ■ ■	■ ■ ■
4 ISA 3 PCI	5 ISA 3 PCI	5 ISA 3 PCI	3 ISA 3 PCI 2 VL	3 ISA 3 PCI 2 VL	5 ISA 3 PCI	4 ISA 3 VL	5 ISA 3 PCI	4 EISA 4 PCI	4 ISA 3 PCI
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Hercules	Hercules	Hercules	Hercules	ATI Graphics	Tseng VGA	STB LightSpeed	STB LightSpeed	STB LightSpeed	Integrate
Stingray S801 (1MB)	Dynabyte (2MB)	Dynabyte (2MB)	Dynabyte (1MB)	Pro Turbo (4MB)	Mentor (1MB)	(2MB)	(2MB)	(2MB)	F64300 (1MB)
503MB IDE	503MB IDE	1GB SCSI-2	401MB IDE	810MB IDE	1GB IDE	528MB IDE	528MB IDE	1.7GB SCSI-2	503MB IDE
Mitsumi	Mitsumi	Mitsumi	Mitsumi	Mitsumi	Toshiba	Matsushita	Plextor 4-Plex	Plextor 4-Plex	NEC
FX001D (2x)	FX001D (2x)	FX001D (2x)	FX001D (2x)	FX001D (2x)	XM-4101B (2x)	CR-562-B (2x)	PK-43CH (4x)	PK-43CH (4x)	CDR-260 (2x)
□ □ □	■ □ □	■ □ □	■ □ □	■ □ □	□ □ □	□ □ ■	□ □ □	□ ■ □	□ □ ■
3.2	3.2	5.1	2.2	3.2	3.2	3.0	3.1	5.0	2.1
0, 3	0, 3	0, 5	0, 1	0, 2	0, 2	0, 3	0, 2	0, 4	0, 2
230W (3)	230W (5)	250W (6)	200W (3)	200W (3)	230W (3)	200W (3)	200W (4)	250W (3)	145W (3)
Infotel SRC 1501P (15")	Infotel SRC 1501P (15")	Infotel SRC 1501P (15")	Mitsuba E462 (14")	Mitsuba E462D (14")	Mitsuba E462D (14")	ADI MicroScan 46P (15")	ADI MicroScan 46P (15")	ADI MicroScan 46P (15")	NEC MultiSync 2V (14")
DOS 6.22, WinWG 3.11	DOS 6.21, WinWG 3.11	DOS 6.21, WinWG 3.11	DOS 6.22, WinWG 3.11	DOS 6.22, WinWG 3.11	DOS 6.22, WinWG 3.11	DOS 6.2, WinWG 3.11	DOS 6.2, WinWG 3.11	DOS 6.22, WinWG 3.11	DOS 6.22, Windows 3.1
3 years/3 years	3 years/3 years	3 years/3 years	2 years/2 years	2 years/2 years	2 years/2 years	1 year/2 years	1 year/2 years	1 year/2 years	3 years/3 years
None	None	None	\$39 (1 year)	\$39 (1 year)	\$39 (1 year)	\$39 (1 year)	\$39 (1 year)	\$39 (1 year)	Included (1 year)

The P66/PCI also did well on our Graphics WinMark tests, but (using a 520MB Conner hard disk) it posted a below-average score on the Disk WinMark tests. Its Winstone score was average.

HiQ has a number of other lines with celestial names such as the Jupiter, which is its multimedia line; the Uranus, which offers dual-Pentium processing and is a server line; the Pluto, which is a high-end EISA/PCI file server line; and the Zenith, which resembles the Neptune line.—WPF

► **HiQ Computer Systems, Sunnyvale, CA; 800-827-5836, 408-245-5836; fax, 408-245-3108.**

Circle 467 on reader service card

IN SHORT

HiQ Neptune II

Roomy systems targeted at the high end of the computer market.



IBM Personal Computer Co.

IBM ValuePoint Performance Series

The ValuePoint Performance Series is IBM's solution for the corporate user—and it will be for the near future, although the company's PC marketing strategy is in transition. (See the sidebar "New Product Branding Strategies" for more information about IBM's new PC lines; see also the First Looks section in this issue for a review of the new IBM Personal Computer 700.)

We received two ISA/VL-Bus ValuePoints: the \$4,504 IBM ValuePoint 100DX4/Dp desktop; and the \$3,374 small-footprint IBM ValuePoint 466DX2/Sp. Though the systems are a bit pricey, both performed strongly relative to other systems in their classes. Each unit also came with a 17-inch monitor, a MediaVision Jazz 16 sound card, and an assortment of software. Both ValuePoints are also backed by a three-year parts and labor warranty.

Each PC's motherboard is clear of cabling and allows access to all components. Both also feature integrated graphics with

2MB of DRAM and integrated floppy disk, hard disk, and I/O controllers.

On most of our Windows-based tests both systems produced above-average scores. The 100DX4/Dp posted Winstone 95 and Disk WinMark 95 scores that were among the best in its group. The 466DX2/Sp had top-ten Disk WinMark and Graphics WinMark 95 scores, as well as a slightly above-average Winstone score.—WPF

► **IBM Personal Computer Co., Somers, NY; 800-772-2227.**

Circle 468 on reader service card

IN SHORT

IBM ValuePoint Performance Series

Slightly pricey workstations with good performance for businesses.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



Power Macintosh

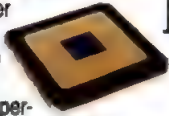
Steve Archibald
Director, Systems for Mass
Markets Service Delivery
US West, Phoenix

During the week, Steve manages the systems and processes that support 12 million customers in 14 western states. On weekends, he jokes on his granddaughter, "takes the dog on the tennis court and, 'when I'm feeling strong,' scales the face of local rock climbing boulders."



"There's leading edge. And bleeding edge. And you

The RISC-based PowerPC™ microprocessor at the heart of every Power Macintosh takes desktop computing to new levels of performance and compatibility. For the name of your nearest authorized Apple reseller, call 800-732-3131, ext. 750, today.



have to walk the line to stay competitive.

That's why we use Power Macintosh. It's a

RISC PC, so it's leading the way. But it's

also a Mac that can run Windows and

DOS, so it's compatible with everything

we're doing now. That makes Power Macintosh a



"In some cases, we used to have three different PCs on one desk—an absolute monument to systems failure. So that's where we put the Power Macintosh first. Now there's one PC per desk, the Power Macintosh. One happy user per desk, too."



Mac OS For Windows

Power Macintosh™ fits right in at US West, where people use many different types of PCs and 30 or so custom DOS and Windows programs. "Power Macintosh helps our people collaborate, no matter what kind of PC they use."

very safe choice. Which is good for a guy

like me. I take my risks on the weekend."

Power Macintosh. The business Macintosh.

Apple

Adding "SoftWindows" from Imaging Solutions Inc. lets you run MS-DOS and Windows 3.1 on a Power Macintosh. © 1994 Apple Computer, Inc. All rights reserved. Apple, the Apple logo and Macintosh are registered trademarks of Apple Computer, Inc. Mac, the Mac OS logo and Power Macintosh are trademarks of Apple Computer, Inc. PowerPC and the PowerPC logo are trademarks of International Business Machines Corporation, used under license herefrom. MS-DOS is a registered trademark and Windows is a trademark of Microsoft Corporation. SoftWindows is a trademark used under license by Imaging from Microsoft Corporation.

► SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company ■ = YES □ = NO	NEC PowerMate P600	NEC Ready 486	NETIS N400P Best Buy	NETIS N500 Best Buy	NETIS N500 PowerStation	NETIS N590 PowerStation	Olivetti M4-486	Olivetti M4-92
List price (tested configuration)	\$3,294 (estimated)	\$3,044 (estimated)	\$2,450	\$3,400	\$3,250	\$3,830	\$2,718	\$4,537
Processor	Intel Pentium/60	Intel 486DX2/66	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60
Installed, maximum motherboard RAM	16MB, 80MB	8MB, 128MB	8MB, 128MB	16MB, 192MB	16MB, 192MB	16MB, 128MB	8MB, 64MB	16MB, 128MB
Installed, maximum external RAM cache	256K, 256K	256K, 256K	256K, 512K	512K, 512K	256K, 512K	512K, 512K	256K, 256K	256K, 256K
Motherboard manufacturer	Intel	NEC	Asus	Asus	Asus	Super Micro	Olivetti	Intel
Chip set manufacturer	Intel	VLSI	Intel	Intel	Intel	OPTI	LMC	Intel
BIOS manufacturer and version (or date)	AMI 1.00.1.BC0K	Phoenix 4.03.6	Award 4.5	Award 4.5	Award 4.5	AMI (12/15/93)	AMI 1.1	AMI 1.00.06.AF2
Flash BIOS/16550 UART chip	■ ■ ■	■ ■ ■	□ □ □	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Expansion-bus slots	4 ISA, 1 PCI	4 ISA, 1 VL	4 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI	3 ISA, 4 PCI, 2 VL	4 ISA, 2 VL	5 ISA, 3 PCI
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1
Graphics adapter (and memory)	Integrated Cirrus Logic GD5434 (1MB)	Integrated C&T F64300 (1MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	Integrated Cirrus Logic GD5428 (1MB)	Matrox MGA-PCI (2MB)
Hard disk capacity and interface	514MB IDE	404MB IDE	427MB IDE	528MB IDE	515MB SCSI-2	1GB SCSI-2	407MB IDE	603MB IDE
CD-ROM drive (and speed)	NEC MultiSpin 3Xi (3x)	NEC CDR-260 (2x)	Mitsumi FX001D (2x)	NEC CD-ROM:500 (3x)	NEC CD-ROM:500 (3x)	NEC CD-ROM:500 (3x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)
Modem/Network adapter/Audio	□ □ □	■ □ □	□ □ □	■ □ □	■ □ □	□ □ □	□ □ □	□ □ □
Accessible drive bays (5.25", 3.5")	2, 1	2, 1	3, 2	3, 2	3, 2	6, 0	2, 1	2, 1
Internal drive bays (5.25", 3.5")	0, 1	0, 1	0, 0	0, 3	0, 0	0, 5	0, 3	0, 3
Power supply (and number of connectors)	145W (3)	145W (5)	250W (4)	230W (4)	230W (4)	250W (5)	200W (6)	200W (6)
Monitor (and diagonal screen size)	NEC MultiSync 2V (14")	NEC MultiSync 17 (17")	View Magic CA-1565 (15")	View Magic CA-1565 (15")	ViewSonic 1584 (15")	ViewSonic 1584 (15")	Olivetti CDU 1764/SA01 (17")	Olivetti CDU 1764/SA01 (17")
System software	DOS 6.22, Windows 3.1	DOS 6.22, Windows 3.1	DOS 6.22, WWG 3.11	DOS 6.22, WWG 3.11	DOS 6.22, WWG 3.11	DOS 6.22, Windows 3.11	DOS 6.2, Windows 3.1	DOS 6.2, WWG 3.11
Warranty on parts/labor	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/1 year	3 years/1 year
On-site service	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

ALI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

Initiative Technologies Inc.

• ITI Series

Initiative Technologies is a Texas-based player in the reseller channel. For this roundup, the company sent us two systems: its low-end, 486DX2/66-based ITI DX2-66, which is targeted mainly at small businesses; and the high-end, 90-MHz Pentium-based ITI M54PI-90, aimed at corporate power users. Both systems are competitively priced (\$1,695 for the ITI DX2-66 and \$3,725 for the ITI M54PI-90) and offer adequate room for expansion, but they were both weak performers on our tests.

The ITI machines are housed in identical desktop cases, which provide plenty of drive bays for future expansion. The major difference between these two



systems is their choice of high-speed expansion bus: the DX2-66 uses a VL-Bus, while the M54PI-90 has a PCI bus. (By the time you read this, ITI says, it will also be selling an EISA/PCI system that supports two 90-MHz Pentium processors.) Both ITI machines employ motherboards with a minor design limitation:

IN SHORT

ITI Series

Affordable and roomy units that are lacking in performance.

two ISA slots in the DX2-66 and one ISA slot in the M54PI-90 cannot accommodate full-length expansion

cards, because they are partially blocked by SIMMs. The ITI M54PI-90 was a consistently below-average performer and had one of the lowest Winstone 95 scores of the Pentium/90 systems that we tested for this roundup. The ITI DX2-66 was a roughly average performer across the board.

—Carol Venezia

► **Initiative Technologies Inc., Brownwood, TX; 800-544-4700, 915-643-1845; fax, 915-643-4912.**

Circle 469 on reader service card

Insight Direct Inc.

PC EDITORS' CHOICE
Insight MM

All three PCs we tested from Insight Direct are geared toward the multimedia market, but Insight's two Pentium units are excellent examples of what can be had today for a relatively affordable price.

These two PCI-based Pentium tower systems—the Editors' Choice \$4,799 90-MHz Insight PCI P90 MM and the \$3,999 66-MHz Insight PCI P66 MM—may at first seem costly, but the prices are fair. They offer performance well above the average for their respective tiers, and an extensive set of multimedia options and software. Priced at \$1,999, the Insight 486DX2-66 MM, a VL-Bus system, can't match the others in terms of



PC Express EXP66	PC Express EXP100	PC Express EXP90	PCG BurStar 466	PCG BurStar P66	PCG BurStar P90	Poly 486-66VP	Poly DX4-100P	Poly 590IP	Precision 486-VIP
\$1,749	\$2,299	\$3,899	\$2,247	\$2,997	\$4,587	\$1,750	\$2,750	\$4,350	\$1,675
Intel 486DX2/66	Intel DX4/100	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66	Intel DX4/100	Intel Pentium/90	Intel 486DX2/66
8MB 64MB	16MB 64MB	16MB 128MB	~8MB 128MB	16MB 128MB	16MB 256MB	8MB 128MB	16MB 128MB	16MB 128MB	8MB 128MB
256K 512K	256K 1MB	256K 256K	256K 1MB	256K 512K	256K 512K	256K 512K	256K 512K	256K 256K	256K 1MB
Firenze	Asus	Intel	ATC	FCI	Intel	Prime	ECS	Intel	Precision
SIS	SIS	Intel	Intel	Intel	Intel	Intel	Intel	Intel	Contaq
Award 4 50G	Award 4 50G	AMI 1 00 03 AX1Z	Award 4 50G	AMI (12/15/93)	AMI 1 00 03 AX1Z	AMI (8/8/93)	Phoenix 1 03	AMI 1 00 03 AX1Z	Award 4 50G
□□	□□	□■	■	□□	■	■	□■	■	■
5 ISA 3 VL	5 ISA 2 VL	5 ISA 3 PCI	4 ISA 3 PCI	5 ISA 4 PCI	5 ISA 3 PCI	2 ISA 4 PCI 3 VL	4 ISA 3 PCI	5 ISA 3 PCI	2 ISA 4 PCI 2 VL
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Hercules	Hercules	Diamond Viper	Photon	Diamond	Diamond	Actix Graphics	ATI Graphics	ATI Graphics	Diamond Viper
Dynalite (1MB)	Dynalite (1MB)	PCI (2MB)	Torpedo864 (2MB)	Stealth 64 (2MB)	Stealth 64 (2MB)	Engine 64 (1MB)	Pro Turbo (2MB)	Pro Turbo (4MB)	PCI (2MB)
475MB IDE	503MB IDE	942MB SCSI 2	540MB SCSI-2	540MB SCSI-2	1GB SCSI-2	341MB IDE	527MB IDE	1 1GB SCSI-2	345MB IDE
Sony	Sony	Sony	Toshiba	Plextor	Toshiba	Optics Storage	Philips	Plextor	Sony
CDU 33A (2x)	CDU 33A (2x)	CDU 33A (2x)	XM 3401B (2x)	DM 3028 (2x)	XM 3401B (2x)	Dolphin AT (2x)	LMS CR328A (2x)	DM 3028 (2x)	CDU 33A (2x)
□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□
3, 1	3, 1	5, 0	2, 1	3, 2	3, 2	3, 1	3, 2	8, 0	2, 1
0, 1	1, 2	1, 4	0, 1	1, 3	0, 3	0, 1	0, 3	2, 0	1, 2
200W (5)	230W (5)	250W (6)	200W (3)	250W (3)	250W (5)	230W (4)	230W (3)	300W (7)	200W (5)
CTX 1451ES (14")	CTX 1562GM (15")	Nokia 447X058 (17")	MAG	MAG	MAG	Optiquest 1000S (14")	Optiquest 1000S (14")	ADI MicroScan 4GP (15")	Viewsonic 17 (17")
DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11
4 years/4 years	4 years/4 years	4 years/4 years	3 years/3 years	3 years/3 years	3 years/3 years	2 years/5 years	2 years/5 years	2 years/5 years	1 year/1 year
Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$75 (1 year)	\$75 (1 year)	\$75 (1 year)	\$50 (1 year)

performance or value.

The 486DX2-66 was a poor performer that posted below-average scores for its tier on our Graphics WinMark 95, CPUmark₁₆, and DOSmark tests. The P66 includes two speakers, a 17-inch monitor, and 35 CD-ROM software titles. It also posted a high Winstone 95 score that rivaled some of the better 90-MHz systems. The P90 is impressive too, offering 13 drive bays, a quadruple-speed CD-ROM drive, and a 17-inch monitor—though it didn't come with as much software as the P66. It turned in scores that were at least slightly above average on

IN SHORT

Insight MM

High-powered systems that come with complete multimedia bundles.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	AVERAGE

every Windows-based test and were substantially above average on the Winstone 95 tests. —WPF

► **Insight Direct Inc., Tempe, AZ;** 800 - 729 - 0770, 602-902-1176; fax, 602-902-1180.

Circle 470 on reader service card

Micro Express

• Micro Express MicroFLEX

Micro Express sent two units from its MicroFLEX line, the \$1,649 Micro Express MicroFLEX-VL/66 and the \$3,399 Micro Express MicroFLEX-VL/P66. Both are aimed at the general-business and small-office markets. Their prices are attractive, and their performance was competitive.

The two tower systems use a combination ISA/VL-Bus expansion-bus design. Unlike many other PCs in this roundup, the MicroFLEX units did not have problems with blocked expansion slots—but be careful when installing or removing cards from the bottom-most slot, as the case's frame has a very sharp edge. In addition to VL-Bus-based 2MB graphics cards and hard disk controllers (both with 1MB cache), Media Vision Pro Audio-Spectrum 16 sound boards are included on both systems.

Relative to the other midrange systems, the MicroFLEX-VL/P66 system had average scores across all our tests, though its score dipped a little below av-

erage on the Disk WinMark 95 tests. The MicroFLEX-VL/66 managed slightly above-average scores in its class on our Winstone 95 tests and average to marginally above-average scores on our DOS-based tests. Its Disk WinMark score was also a few points below average.

Micro Express offers a two-year warranty. Technical-support hours are also longer than usual (24-hour, 7-day), though calls made during non-standard hours are not toll-free and are routed through a beeper system to connect you to a technician. —AY

► **Micro Express, Santa Ana, CA;** 800 - 989 - 9900, 714-852-1400; fax, 714-852-1225.

Circle 471 on reader service card

IN SHORT

Micro Express MicroFLEX

A line of competitive business units with attractive prices.



SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company									
	Precision FTI-88	Precision FTI-99	Robotech Cobra RS-DX2/66	Robotech Cobra RS-DX4/100	Robotech Cobra RS-P90	Royal 486/66 Media Master III	Royal P/66 Media Master IV	Royal P/90 Ultra Media	
List price (tested configuration)	\$2,575	\$3,250	\$1,999	\$2,599	\$4,779	\$1,845	\$2,995	\$3,595	
Processor	Intel Pentium/60	Intel Pentium/60	Intel 486DX2/66	Intel DX4/100	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	
Installed, maximum motherboard RAM	16MB, 128MB	16MB, 128MB	8MB, 128MB	16MB, 128MB	16MB, 128MB	8MB, 128MB	16MB, 128MB	16MB, 128MB	
Installed, maximum external RAM cache	256K, 256K	256K, 256K	256K, 1MB	256K, 1MB	256K, 256K	256K, 512K	256K, 512K	256K, 256K	
Motherboard manufacturer	Intel	Intel	Robotech	Robotech	Intel	Genoa	Microstar	Intel	
Chip set manufacturer	Intel	Intel	Contaq	Contaq	Intel	Intel	Intel	Intel	
BIOS manufacturer and version (or data)	AMI 1.00.03.AF2	AMI 1.00.08.AX1	AMI (8/8/94)	AMI (8/8/93)	AMI 1.00.03.AX12	Award 4.50G	Award 4.50G	AMI 1.00.03.AX12	
Flash BIOS/16550 UART chip	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
Expansion-bus slots	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 VL	5 ISA, 3 VL	5 ISA, 3 PCI	5 ISA, 4 PCI	5 ISA, 4 PCI	5 ISA, 3 PCI	
Parallel, serial, mouse ports	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	
Graphics adapter (and memory)	Diamond Viper PCI (2MB)	ATI Graphics Pro Turbo (4MB)	Genoa Hornet 8300 (1MB)	Genoa Hornet 8300 (1MB)	Genoa Phantom 64 (1MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	
Hard disk capacity and interface	528MB IDE	1GB SCSI-2	430MB IDE	527MB IDE	730MB IDE	527MB IDE	1GB SCSI-2	772MB IDE	
CD-ROM drive (and speed)	NEC CDR-510 (3x)	NEC CDR-510 (3x)	Matsushita CR-563-B (2x)	Matsushita CR-563-B (2x)	Plextor 4-Plex PX-43CH (4x)	Mitsumi FX001D (2x)	NEC CDR-510 (3x)	NEC CDR-510 (3x)	
Modem/Network adapter/Audio	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	
Accessible drive bays (5.25", 3.5")	2, 1	2, 1	3, 1	3, 1	4, 1	3, 2	3, 2	3, 2	
Internal drive bays (5.25", 3.5")	1, 2	1, 2	0, 1	0, 1	0, 4	0, 3	0, 3	0, 3	
Power supply (and number of connectors)	250W (5)	250W (5)	230W (4)	230W (4)	230W (6)	230W (4)	230W (4)	230W (5)	
Monitor (and diagonal screen size)	ViewSonic 17 (17")	ViewSonic 17 (17")	Robotech Cobra RS 1428NI (14")	Robotech Cobra RS 1428NI (14")	Toscan Omniscan CM-20MKR (20")	KFC CA1507 (15")	KFC CA1507 (15")	MAG Innovision DX17F (17")	
System software	DOS 6.22, WinV9 3.11	DOS 6.22, WinV9 3.11	DOS 6.2, WinV9 3.11	DOS 6.2, WinV9 3.11	DOS 6.2, WinV9 3.11	DOS 6.2, WinV9 3.11	DOS 6.2, WinV9 3.11	DOS 6.2, WinV9 3.11	
Warranty (at point of sale)	1 year/1 year	1 year/1 year	2 years/2 years	2 years/2 years	2 years/2 years	1 year/lifetime	1 year/lifetime	1 year/lifetime	
On-site service	\$50 (1 year)	\$50 (1 year)	None	None	None	\$45 (1 year)	\$45 (1 year)	\$45 (1 year)	

ALI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., CBT—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., VLSI—VLSI Integration, VSC—VSC Technology Inc.

Micron Computer Inc.

• Micron Magnum and PowerStation

Micron Computer has proven once again that it can build quality PCs at reasonable prices. The business-oriented, \$3,527 Pentium/90-based Micron P90PCI PowerStation—an Editors' Choice winner of June 28, 1994—the power-user's \$2,928 DX4/100-based Micron 4100PCI Magnum, and the entry-level \$2,149 DX2/66-based Micron 466PCI Magnum all produced top scores on our performance tests.

The three units come in no-tools desktop cases. The two Magnums offer six ISA and three PCI slots, while the PowerStation has five ISA and three PCI. All three came with a PCI-based Diamond Stealth 64 graphics board. These PCs use different motherboards but integrate I/O ports and floppy and hard disk controllers.

The units' performance lived up to the high standards we've come to expect from Micron. All three produced terrific Winstone 95 scores for their classes, with the 4100PCI near the top of all midrange sys-

tems. In fact, the 4100PCI posted above-average scores on all Windows-based tests.

The P90PCI managed at least slightly above-average scores for its tier on all tests except the DOS Video tests, where it was average. The 466PCI posted above-average scores almost across the board, finishing near the top on the Disk WinMark 95, Graphics WinMark 95, and CPUmark₁₆ tests.—Robert S. Anthony

► **Micron Computer Inc., Nampa, ID: 800-388-6334, 208-465-3434; fax, 208-463-3424.**

Circle 472 on reader service card



IN SHORT

Micron Magnum and PowerStation

No-frills performance leaders for the general business market.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

MicroTech Computer Corp.

• MicroTech Ultima

MicroTech targets its Ultima line at professionals and small- or home-office users. The Ultima line is visually distinctive—all black mini-tower cases are standard, complete with matching monitors, keyboards, and mice. The systems' performance is average for their respective groups.

We tested two Ultima units—the Pentium/90-based, \$5,195 MicroTech Ultima MP5/90 and a 486DX2/66-based, \$2,495 Ultima XVC/66. The MP5/90 also included a triple-speed CD-ROM drive (\$459), a 17-inch monitor and a 1GB SCSI hard disk.

As tested, there were four drive bays free in each system. Four of five ISA and one of two VL-Bus slots were unused in the XVC/66; all ISA slots and one of three PCI slots were free in the MP5/90. One ISA slot in each system, plus one VL-Bus slot in the XVC/66 and the shared PCI/ISA slot in the MP5/90, cannot accept full-length cards, because of the placement of the CPU. SIMM sockets block two ISA slots in the XVC/66. You

Seairix ASI 9000 486DX266/08L	Seairix ASI 9000 486DX499/16L	Sidus Formula SCI966DC256DT	Sidus Formula SCI9P590PDT	Sys Business P66	Sys Performance P90	Targam Thunderbolt ZR	Targam Thunderbolt XL	Tangent DX2/66	Tangent DX4/100
\$2,425	\$3,670	\$2,490	\$2,902	\$2,559	\$3,299	\$1,759	\$2,659	\$1,745	\$2,459
Intel 486DX2/66	Intel DX4/100	Intel DX4/100	Intel Pentium/90	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel DX4/100	Intel 486DX2/66	Intel DX4/100
4MB 64MB	16MB 64MB	16MB 64MB	16MB 128MB	16MB 192MB	16MB 768MB	8MB 64MB	16MB 64MB	8MB 64MB	16MB 64MB
256K 256K	256K 256K	256K 256K	256K 256K	256K 512K	256K 512K	256K 512K	256K 512K	256K 512K	256K 512K
Seairix	Seairix	Micronics	Intel	GBT	GBT	Targam	Targam	FCT	FCT
OPTi	OPTi	Micronics	Intel	Intel	Intel	OPTi	OPTi	SIS	SIS
Microid 1.6	Microid 1.6	Phoenix 0.1	AMI 1.00/08 AX1	Award 4.50G	Award 4.50G	AMI (8/8/93)	AMI (8/8/93)	Award 4.50G	Award 4.50G
□□	□□	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
5 ISA 2 VL	5 ISA 2 VL	5 ISA 2 VL	5 ISA 3 PCI	4 ISA 4 PCI	4 ISA 4 PCI	4 ISA 1 VL	5 ISA	5 ISA 3 VL	5 ISA 3 VL
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0
Seairix ASI	Seairix ASI	ATI Graphics	ATI Graphics	Diamond	ATI Graphics	Integrated	Integrated	Ark 1000VL2M	Diamond
16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB	16MB 128MB
365MB IDE	548MB IDE	527MB IDE	730MB IDE	503MB IDE	1GB IDE	503MB IDE	503MB IDE	405MB IDE	504MB IDE
Mitsumi	Mitsumi	Sony	Sony	Sony	Sony	Mitsumi	Teac	Sony	Sony
FX001D (2x)	FX001D (2x)	CDU 33A (2x)	CDU 33A-01 (2x)	CDU 33A (2x)	CDU 33A (2x)	FX001D (2x)	CD 55A (4x)	CDU 33A (2x)	CDU 33A (2x)
□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□	□□□
3, 2	3, 2	2, 1	2, 1	3, 0	3, 1	2, 2	3, 1	3, 2	3, 0
0, 2	0, 2	1, 1	1, 1	0, 2	0, 2	0, 0	0, 2	0, 0	0, 3
230W (5)	230W (5)	200W (3)	200W (3)	200W (4)	200W (4)	200W (3)	250W (3)	250W (4)	200W (4)
KFC CA1505 (15")	KFC CA1505 (15")	Sidus SID 1500N (15")	Sidus SID 1500N (15")	KFC CA1507 (15")	KFC CA1507 (15")	Proton DH1448 (14")	Optiquest 2000DS (15")	Tangent SM-5515CP (15")	ADI MicroScan 4GP (15")
DOS 6.21, WinVWG 3.11	DOS 6.21, WinVWG 3.11	DOS 6.21, WinVWG 3.11	DOS 6.22, WinVWG 3.11	DOS 6.21, WinVWG 3.11	DOS 6.21, WinVWG 3.11	DOS 6.22, WinVWG 3.11	DOS 6.22, WinVWG 3.11	DOS 6.2, WinVWG 3.11	DOS 6.22, WinVWG 3.11
3 years/1 year	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year
None	None	\$25 (1 year)	\$25 (1 year)	None	None	\$30 (1 year)	\$30 (1 year)	Included (1 year)	Included (1 year)

may find you don't need all the slots, because I/O and floppy disk controllers are integrated in both systems; the XVC/66 also uses the motherboard's integrated disk controller.

Neither unit was a star performer on our tests, but both did fairly well. Within the high-end class, the MP5/90 posted average scores, with an above-average score on our DOS Disk tests. The XVC/66 fell below average on our Winstone 95 tests, but otherwise kept within the average for entry-level systems.—AY

► **MicroTech Computer Corp.,** Canton, GA; 800-342-6508, 404-345-6508; fax, 404-345-5550.

Circle 473 on reader service card

IN SHORT
MicroTech Ultima
PCs with average performance aimed at the professional market.



MidWest Micro

• MidWest Micro Elite

According to MidWest Micro, the systems we tested are geared toward the small-office and corporate markets. The MidWest Micro Elite P5-90 full-size tower costs \$3,860; the MidWest Micro Elite P5-66 midsize tower is \$2,599; and the MidWest Micro Elite DX2-66 PCI mini-tower costs \$1,899. The P5-66 and DX2-66 were stronger performers within their respective groups than the P5-90 was within its group of high-end systems. All are affordable, and each offers comparatively average performance. MidWest Micro backs these systems with a three-year warranty.

With eight drive bays, the P5-66 offers almost as much expansion room in its midsize tower case as the P5-90. The disk subsystem uses the motherboard's integrated controller. The P5-90 uses a Seagate 1GB SCSI-2 hard disk with a PCI-based SCSI controller that can accommodate additional devices externally. Each of the three systems use a Hercules PCI-based graphics accelerator card.

Even with the PCI/SCSI controller, the P5-90 produced a slightly below-average score on our Disk WinMark 95 and Winstone 95 tests compared to other high-end systems. Its Graphics WinMark 95 score was average. Within their respective groups, the P5-66 and the DX2-66 posted average to just above-average numbers on all Windows-based tests. The P5-66's Winstone score was particularly strong compared with that of the other MidWest Micro Elite systems: It beat the score posted by the P5-90 by several points.—WPF

► **MidWest Micro, Fletcher, OH;** 800-682-7256, 513-368-2309; fax, 800-562-6622.

Circle 474 on reader service card

IN SHORT
MidWest Micro Elite
Well-priced systems with a good warranty aimed at business users.



45 minutes ago you were

drawing flow

charts, even

plans

"Geez, I didn't

could do all that.

You just sip your coffee.

Forget the colored tights. The flowing cape. And the chrome underwear. You don't need them to be a superhero. All you need is Windows.[®] An hour. And Visio[™] software. It's graphics software that gives you the power to do things you never dreamed of doing. Like drawing a flowchart and putting it into a memo. The big word here is ENABLING. With Visio, you can effortlessly drop graphics into your business documents. No other business graphics program lets you do so much, so fast, with such superhuman efficiency. With 22 stencils and over 750 pre-drawn SmartShapes,[™] you can draw all

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kinds of stuff. (Without actually drawing a darn thing.) Block diagrams. Project timelines. Engineering schematics. You name it.

re a *mere mortal*. Now you're

charts, organizational

en space

ns, and someone says,

dn't know *You*

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Visio and your Windows applications.

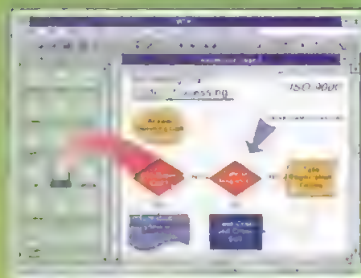
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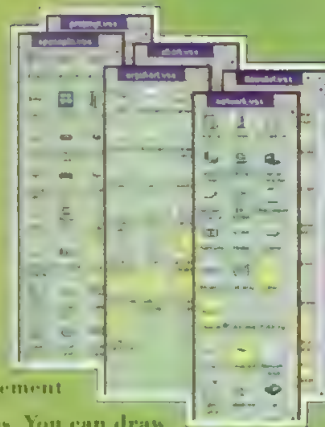
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Visio is packed with 22 stencils and well over 750 SmartShapes. So what does this mean for you? Well, it means you can draw space plans. You can draw Total Quality Management (TQM) diagrams. You can draw maps. You can draw and draw and draw till it hurts.



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Business drawing for people whose business isn't drawing.™

SUMMARY OF FEATURES

Pentium and 486 PCs

In alphabetical order by company ■ = YES □ = NO		Tangent PC1590	Tri-Star Tri-CAD 486DX2/66	Tri-Star Tri-CAD Pentium 66	Tri-Star Tri-CAD Vigor	Unitek UT-486DX2/66LB	Unitek UT-P60	Unitek UT-P90	Vektren Edutainment Multimedia/ 486DX266
List price (tested configuration)		\$3,695	\$2,155	\$3,255	\$5,245	\$1,695	\$2,339	\$3,279	\$1,595
Processor		Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66
Installed, maximum motherboard RAM		16MB, 128MB	8MB, 64MB	16MB, 128MB	16MB, 128MB	8MB, 128MB	16MB, 128MB	16MB, 128MB	8MB, 64MB
Installed, maximum external RAM cache		256K, 256K	256K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	128K, 1MB
Motherboard manufacturer		Intel	GBI	Intel	Intel	Shuttle	Intel	Intel	Asus
Chip set manufacturer		Intel	SIS	Intel	Intel	VIA	Intel	Intel	SIS
BIOS manufacturer and version (or date)		AMI 1.00.03 AX1Z	Award 4.50G	AMI 1.00.08 AF2	AMI 1.00.06 AX1	AMI (6/6/92)	AMI 1.00.06 AF1	AMI 1.00.03 AX1Z	Award 4.50G
Fresh BIOS/16550 UART chip		■ ■	□ □	□ ■	■ ■	□ ■	■ ■	■ ■	□ □
Expansion-bus slots		5 ISA, 3 PCI	4 ISA, 3 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 VL	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 2 VL
Parallel, serial, mouse ports		1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)		Diamond Stealth 64 (2MB)	ATI Graphics Wonder (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (4MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Pro Turbo (4MB)	Diamond Speedstar Pro (1MB)
Hard disk capacity and interface		1GB IDE	341MB IDE	540MB IDE	1GB SCSI-2	425MB IDE	541MB IDE	168 IDE	341MB IDE
CD-ROM drive (and speed)		Sony CDU 33A (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Sony CDU 33A (2x)	Mitsumi FX01D (2x)
Modem/Network adapter/Audio		□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	□ □ □	■ □ ■
Accessible drive bays (5.25", 3.5")		3, 0	3, 2	3, 2	4, 0	2, 2	3, 1	4, 1	2, 2
Internal drive bays (5.25", 3.5")		0, 3	0, 2	0, 2	2, 0	0, 1	0, 1	4, 0	0, 1
Power supply (and number of connectors)		200W (4)	200W (3)	200W (3)	250W (4)	230W (3)	230W (3)	230W (4)	250W (4)
Monitor (and diagonal screen size)		Tangent SM-5515GP (15")	ADI MicroScan 4GP (15")	ADI MicroScan 5EP (15")	ViewSonic 2182-1 (21")	Optiquest 2000DS (15")	Optiquest 2000DS (15")	Optiquest 2000DS (15")	ADI MicroScan 3GP (14")
System software		DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.21, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.22, WWVG 3.11	DOS 6.21, WWVG 3.11
Warranty on parts/labor		1 year/1 year	2 years/lifetime	2 years/lifetime	2 years/lifetime	1 year/1 year	1 year/1 year	1 year/1 year	3 years/lifetime
On-site service		Included (1 year)	None	None	None	\$45 (1 year)	\$45 (1 year)	\$45 (1 year)	Included (1 year)

AI—Acer Labs Inc., AMI—American Megatrends Inc., BCM—BCM Advanced Research Inc., C&T—Chips & Technologies Inc., ECS—Elitegroup Computer Systems Inc., FCI—Free Computer Inc., GBT—Giga-Byte Technology, HP—Hewlett-Packard Co., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., TMC—TMC Research, UMC—United Microelectronics Corp., USA—USA Integration, VLSI—VLSI Technology Inc.

Mitsuba Corp.

Mitsuba Professional Series

Mitsuba sells through VARs rather than direct; the vendor sent us three PCs configured as a VAR would sell them to end users. Mitsuba and its partners can provide you with software and other basic hardware for networking. We received three units: the \$2,950 Mitsuba Fileserver-P-90 PCI/ISA tower with a 1GB hard disk; the \$3,195 Mitsuba i486DX4-100 PCI/ISA/VL-Bus desktop with a 14.4-Kbps fax modem and a 17-inch monitor; and the \$1,699 Mitsuba i486DX2-66 PCI/ISA/VL-Bus mini-tower with a 14.4-Kbps fax modem. Prices are competitive, but Windows performance was uneven.

The Fileserver-P-90 posted average Winstone 95 and Graphics WinMark 95 scores and one of the best Disk WinMark 95 scores in its group. The i486DX4-100, though configured as a Windows workstation, posted a below-average Winstone score and average scores on the other Windows tests compared with units in its

midrange group. The i486DX2-66's scores were average across the board relative to its group. (Both the i486DX4-100 and the i486DX2-66 used an OPTi chip set, which we have found introduces timing delays in PCI-bus transfers.)

Only the i486DX4-100 runs into problems with slots. One VL-Bus slot is taken by the I/O and hard disk controller, and the ports are run out the backplate of a neighboring ISA slot. CPU placement also makes it impossible to use full-length cards in one ISA slot and the shared slot.—AY

► **Mitsuba Corp.**
La Verne, CA;
800-648-7822, 909-392-2000; fax, 909-392-2021.

Circle 475 on reader service card



National MicroComputers

NMC Business Systems

National MicroComputers' Business Systems line is aimed at corporate, government, and high-end users. The machines are reasonably priced at \$1,958 for the NMC Pro-System 466, a 486DX2/66 VL-Bus/ISA desktop; \$3,297 for the NMC Expert-System P66, a Pentium/66 PCI/ISA mini-tower; and \$4,634 for the NMC Expert-System+ DP90, a tower PCI/EISA Pentium/90 system with a 1.8GB SCSI-2 hard disk. The Pro-System and the Expert-Server+ both support a second Pentium CPU. The units' Windows performance was generally good.

None of the units have integrated I/O or floppy disk controllers, a problem only in the Pro-System, where space is already at a premium. Each is unable to take full-length cards in certain slots because of the CPU's placement. As configured for our testing, the Expert-Server+ had no PCI slots free: One slot is used for a voltage converter card,

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Vektron PCI Professional Multimedia/Pentium 60	Vektron PCI Multimedia Ultimate/Pentium 90	Vektron Windows Power Station/486DX266	Vektron PCI Power Station/Pentium 60	Vektron PCI Power Ultimate/Pentium 90	Xinetron X/LAN 486/66	Xinetron X/LAN P66	Xinetron X/LAN P90	ZDS Z-Station 500	ZDS Z-Station EX
\$2 795	\$3 495	\$1 495	\$2 395	\$2 995	\$1 795	\$3 895	\$5 399	\$3 692	\$5 327
Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/60	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90	Intel 486DX2/66	Intel Pentium/90
16MB 192MB	16MB 128MB	8MB 64MB	16MB 192MB	16MB 128MB	8MB 32MB	16MB 128MB	16MB 128MB	8MB 128MB	16MB 128MB
256K 512K	256K 512K	128K 1MB	256K 512K	256K 512K	256K 256K	512K 512K	512K 512K	256K 512K	256K 256K
Asus	TMC	Asus	Asus	TMC	J Bond	Super Micro	Super Micro	Zenith	Intel
OPTi	OPTi	SIS	Intel	OPTi	SIS	OPTi	OPTi	Intel	Intel
AMI G4ZZ	AMI G4ZZ	Award 4.50G	Award 4.5	AMI G4ZZ	AMI (9/26/93)	AMI (12/15/93)	AMI (12/15/93)	Phoenix 1.03	AMI 9.99.99 8FOU
3 ISA, 3 PCI	3 ISA, 3 PCI	5 ISA, 2 VL	5 ISA, 3 PCI	3 ISA, 4 PCI 2 VL	2 ISA 2 VL	3 ISA, 4 PCI 2 VL	3 ISA, 4 PCI 2 VL	3 ISA, 2 PCI	3 ISA, 2 PCI
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 1, 1	1, 2, 1
Diamond	Diamond	Diamond	Hercules	Diamond	Tseng ET4000/	ATI Graphics	ATI Graphics	Integrated ATI	Integrated ATI
Stealth 64 (2MB)	Stealth 64 (2MB)	Speedstar Pro 1MB	Stingray S801 (1MB)	Stealth 64 (2MB)	W32P based (1MB)	Pro Turbo (2MB)	Pro Turbo (2MB)	Mach32 (1MB)	Mach64 (2MB)
544MB SCSI-2	1.1GB SCSI-2	341MB IDE	528MB IDE	1.1GB SCSI-2	345MB IDE	540MB SCSI-2	1.7GB SCSI-2	340MB IDE	729MB IDE
Pentax 4 Plex PX 43CH (4x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Toshiba XM-3401B (2x)	Toshiba XM-3401B (2x)	Toshiba XM-4101B (2x)	Mitsumi FX001DE (2x)
3.2	3.2	2.2	3.2	3.2	2.2	2.2	4.0	2.1	2.1
0.3	0.2	0.1	0.2	0.3	0.0	0.1	3.0	0.1	0.1
750W (3)	250W (3)	250W (4)	250W (4)	250W (3)	230W (3)	230W (4)	250W (5)	150W (4)	145W (3)
ADI MicroScan 4GP (15")	ADI MicroScan 4GP (15")	ADI MicroScan 4GP (15")	ADI MicroScan 4GP (15")	ADI MicroScan 4GP (15")	SOCOS DM-1488 (14")	SOCOS DM-1488 (14")	SOCOS DM-1488 (14")	Nokia ZCM-1740-UT (17")	Nokia ZCM-1740-UT (17")
DOS 6.21, W/WG 3.11	DOS 6.21, W/WG 3.11	W/WG 3.11	DOS 6.21, W/WG 3.11	DOS 6.21, W/WG 3.11	DOS 6.22, Windows 3.11	DOS 6.2, Windows 3.11	DOS 6.2, Windows 3.11	DOS 6.21, W/WG 3.11	DOS 6.2, W/WG 3.11
3 years/lifetime	3 years/lifetime	3 years/lifetime	3 years/lifetime	3 years/lifetime	1 year/3 years	1 year/3 years	1 year/3 years	3 years/3 years	3 years/3 years
Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$125 (1 year)	\$225 (1 year)	\$225 (1 year)	Included (1 year)	Included (1 year)

which the company says is no longer required in currently shipping systems.

The Expert-System yielded a higher Winstone 95 score than the faster Expert-Server+—perhaps because of its Tekram 4MB caching controller, since both had identical graphics cards. The Expert-Server+ and the Pro-System posted average Winstone scores for their groups. On the rest of our Windows-based tests, the NMC units posted average to above - average scores for their groups.—AY

► **National MicroComputers.** Salt Lake City, UT; 800-424-2983, 801-265-3700; fax, 801-265-3783.

Circle 476 on reader service card



NEC Technologies Inc.

EDITORS' CHOICE NEC PowerMate Series

NEC Technologies's PowerMate Series offers good performance, quality documentation, and a clean interior design. The NEC PowerMates are aimed at networked corporate environments; they dispense with the hefty software bundles that come with the NEC Ready Multimedia Series (reviewed separately). The \$1,754 486DX2/66-based NEC PowerMate 466D we tested performed near the top of its class and earns Editors' Choice honors, while the \$3,294 Pentium/60-based NEC PowerMate P60D posted average scores.

Both slimline PowerMates have integrated graphics subsystems, I/O ports, and IDE and floppy disk controllers. Both have Creative Labs Sound Blaster 16 sound cards, though their CD-ROM drives differ: The 466D uses an NEC double-speed IDE CD-ROM drive; the P60D has an NEC triple-speed SCSI CD-ROM drive. The P60D has four ISA slots and one PCI slot on a riser card; the 466D has four ISA slots

and one VL-Bus slot on a riser card.

The two systems turned in average Winstone 95 scores. The 466D posted the third-highest DOS Video score in this entire roundup and was ahead of most of its class on all other test scores, except its Disk WinMark 95 score, which was average. The P60D posted average scores in its group, with the exception of a somewhat below - average Disk WinMark 95 score.—RSA

► **NEC Technologies Inc.** Boxborough, MA; 800 - 632 - 4636, 508-264-8000; fax, 508-264-8831.

Circle 477 on reader service card



IN SHORT	
NEC PowerMate Series	
Well-integrated corporate workstations for office automation tasks.	
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

SUMMARY OF FEATURES

ENDS

Pentium and 486 PCs

In alphabetical order by company

■ = YES □ = NO

List price (tested configuration)

	ZEOS Pantera 486DX2-66	ZEOS Pantera Pentium-66	ZEOS Pantera Pentium-90
Processor	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/90
Installed, maximum motherboard RAM	8MB, 128MB	16MB, 192MB	16MB, 384MB
Installed, maximum external RAM cache	256K, 256K	256K, 512K	256K, 512K
Motherboard manufacturer	ZEOS	ZEOS	ZEOS
Chip set manufacturer	Intel	Intel	Intel
BIOS manufacturer and version (or date)	Phoenix 4.03	Phoenix 4.03	Phoenix 4.03
Flash BIOS/16550 UART chip	■	■	■
Expansion-bus slots	5 ISA, 3 PCI	5 ISA, 3 PCI	5 ISA, 3 PCI
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0
Graphics adapter (and memory)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)
Hard disk capacity and interface	640MB IDE	1GB IDE	1GB IDE
CD-ROM drive (and speed)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)	Mitsumi FX001D (2x)
Modem, Network adapter/fax/modem	□□□	□□□	□□□
Accessible drive bays (5.25", 3.5")	2, 2	2, 2	4, 0
Internal drive bays (5.25", 3.5")	1, 1	1, 1	2, 4
Power supply (and number of connectors)	200W (4)	200W (4)	200W (3)
Monitor (and diagonal screen size)	ZEOS 15 (15")	ZEOS 15 (15")	ZEOS 15 (15")
System software	DOS 6.21, WWG 3.11	DOS 6.21, WWG 3.11	DOS 6.21, WWG 3.11
Warranty on parts/labor	1 year/1 year	1 year/1 year	1 year/1 year
On-site service	\$50 (1 year)	\$50 (1 year)	\$50 (1 year)

NEC Technologies Inc.

• NEC Ready Multimedia Series

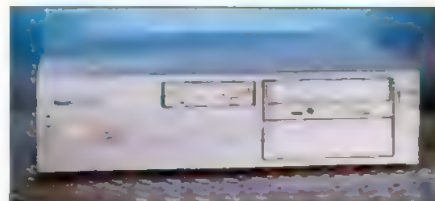
NEC Technologies' Ready Multimedia Series of PCs aims to be just that—ready for work or play as soon as you get them home or to your office. Unlike the NEC PowerMate Series, aimed at corporate users, the Ready machines offer a large software bundle, ample documentation, and an instructional video. For this roundup, we looked at the \$3,044 486DX2/66-based NEC Ready 466D. We had planned to test the DX4/100-based NEC Ready 4100M, but it has been discontinued and replaced with the Pentium/60-based NEC Ready P60M mini-tower.

The 466D is highly integrated and includes the graphics subsystem, I/O ports, and floppy and hard disk controllers. The 466D's four ISA and one VL-Bus slots are on a riser card, which keeps the interior layout clean. To make servicing easier, a sticker inside the case lists the motherboard jumper locations and settings.

The unit came with a 17-inch monitor,

a double-speed NEC IDE CD-ROM drive, a Sound Blaster 16 sound board, and a 2,400-/9,600-bps data/fax modem card.

The 466D posted the second-highest DOS Video score in this roundup. Its



DOSmark, CPUmark₁₆, and Graphics WinMark 95 scores were above average for its group. Its other scores were average.—RSA

► **NEC Technologies Inc.** Boxborough, MA; 800-632-4636, 508-264-8000; fax, 508-264-8831.

Circle 477 on reader service card

NETis Technology Inc.

• NETis Best Buy

The Best Buy series from NETis Technology represents the company's offering for the home PC market. NETis also offers the PowerStation line of business-oriented systems (reviewed separately). We received two Best Buy systems: the NETis N466P Best Buy, a 486DX2/66-based desktop unit, and the NETis N566 Best Buy, a Pentium/66-based mini-tower. Both PCI-based units performed competitively on our tests within their tiers.

Both are also well priced—the N466P at \$2,450 and the N566 at \$3,400—considering their components. The N466P came with a double-speed CD-ROM drive, an ATI Graphics Pro Turbo graphics card with 2MB of VRAM, and a BusLogic PCI hard disk controller with 2MB of RAM. The N566 came with a triple-speed CD-ROM, a Sound Blaster 16 audio card, and the same ATI and BusLogic cards.

On our benchmark tests, the N466P was a strong performer in the entry-level group—especially under Windows, where it posted above-average scores on our Winstone 95 and Graphics WinMark 95 tests. The N566 also did well against the other midrange units, with above-average Graphics WinMark and Winstone scores.

The only area in which these units suffered was in integration. Both have 5.25- and 3.5-inch floppy disk drives—separate units that use up two drive bays. Each uses an ISA slot for an I/O and floppy disk controller card. Ports from this card are strung through the back panel of another slot, limiting its use.—CAV

► **NETis Technology Inc.** Milpitas, CA; 800-577-7526, 408-263-0368; fax, 408-263-4624.

Circle 478 on reader service card

IN SHORT

NETis Best Buy

*Well-priced systems
with good
performance for the
home market.*



The ZEOS[®] Pantera— Hot, Hotter, Hottest.



Some like it hot—we know you like it hotter.

Some think it's cool to be hot. We *are* cool because we are so *totally* hot. See for yourself. Check out *PC Magazine's* sizzling reviews of our ZEOS Pantera 486DX2-66, Pentium-66 and Pentium-90 systems in this issue. They're winning award after award (22 to date),

review after review, magazine after magazine!

There's no hotter ticket around. The ZEOS Pantera gives you superior performance, super power and great expandability—all at an incredibly affordable price. How can you miss with such cool values? It's hot stuff. To get the hottest PC available, call a ZEOS Systems Consultant today at 800-554-7172.

The Hot Pantera 486DX2-66 \$2095

- Genuine Intel 486DX2-66 processor
- 8MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM, 3.5" 1.44MB floppy drive
- Diamond Stealth 64-bit PCI local bus SVGA color graphics card with 2MB VRAM
- 15" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch
- Two high-speed serial ports, one enhanced parallel port
- Optional on-board Fast SCSI-2
- Six-bay desktop case
- 101-key space-saving keyboard
- Microsoft Mouse
- Microsoft DOS 6.2 and Windows for Workgroups 3.11

The Hotter Pantera Pentium-66 \$2995

- Genuine Intel Pentium-66 processor
- 16MB RAM, 256K SRAM cache
- 1GB local bus IDE hard drive, 256K cache
- 2X CD-ROM, 3.5" 1.44MB floppy drive
- Diamond Stealth 64-bit PCI local bus SVGA color graphics card with 2MB VRAM
- 15" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch
- Two high-speed serial ports, one enhanced parallel port
- Integrated business audio
- Optional on-board Fast SCSI-2
- Six-bay desktop case
- 101-key space-saving keyboard
- Microsoft Mouse
- Microsoft DOS 6.2 and Windows for Workgroups 3.11
- Lotus SmartSuite

The Hottest Pantera Pentium-90 \$3195

- Genuine Intel Pentium-90 processor
- 16MB RAM, 256K SRAM cache
- 1GB local bus IDE hard drive, 256K cache
- 2X CD-ROM, 3.5" 1.44MB floppy drive
- Diamond Stealth 64-bit PCI local bus SVGA color graphics card with 2MB VRAM
- 15" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch
- Two high-speed serial ports, one enhanced parallel port
- Integrated business audio
- Optional on-board PCI local bus Fast SCSI-2
- Optional on-board PCI local bus ethernet
- Ten-bay vertical case
- 101-key space-saving keyboard
- Microsoft Mouse
- Microsoft DOS 6.2 and Windows for Workgroups 3.11
- Lotus SmartSuite

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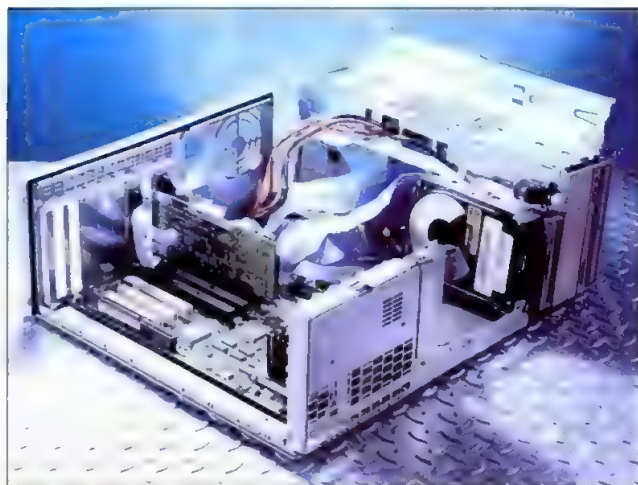


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CIRCLE 125 ON READER SERVICE CARD

Picks & Pans

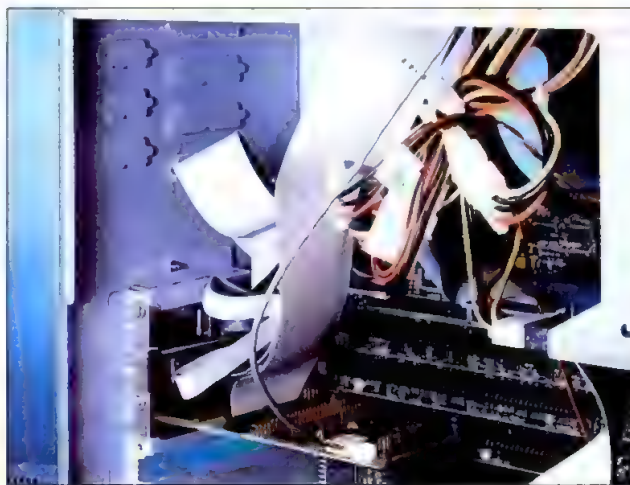
Our look at 165 PCs based on 486 or Pentium processors generated a long list of features we liked and didn't like—things we thought were designed well and those that could have been better. Here are some of our favorites:



Olivetti M4-82



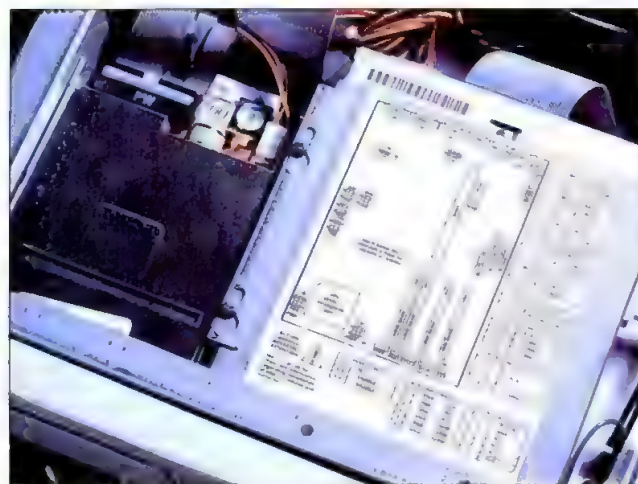
Breakaway cases. Some systems swivel apart so you can get easy access to all the internal components and use thumbscrews or clasps to secure the case, so tools aren't required to open them.



PC Express EXP90



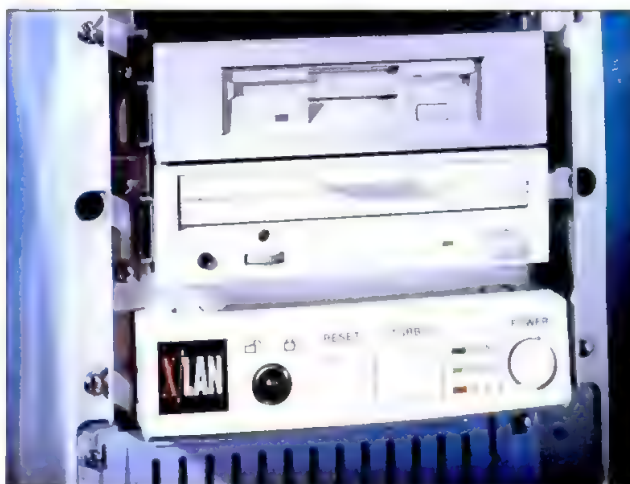
Misplaced I/O ports. With cutouts available in this system's case, why route parallel and serial port connectors through the backplate of ISA expansion slots?



ZDS Z-Station EX



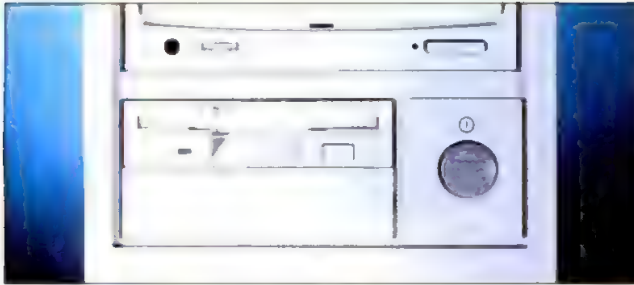
Motherboard schematic. You don't need to have the manual handy to figure out where motherboard components are located, thanks to this schematic pasted to the drive cage.



Xinetron X/LAN P90



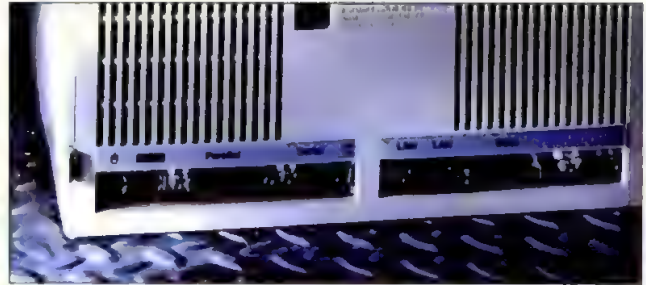
Turbo switches. Anachronisms from the PC/AT days that are still found on plenty of systems. Somehow we doubt you'll really want to run that Pentium/90 at 8 MHz.



Tri-Star Tri-CAD Pentium 66



Power protection. A recessed Reset button makes it nearly impossible to restart your machine by mistake. This is an easy design modification that cuts the potential for losing data.



HP Vectra XU 5/90C



Legible labels. The way back-panel labels should look: no arcane icons to misinterpret and no embossed white-on-white labels that are unreadable in low light.



AT&T Globalyst 600



Power-Down preventative. If you've ever turned off your PC and regretted it a moment later, you'll appreciate this interlock: The power button won't release unless you also press the smaller orange button on top of the unit.



Dell OmniPlex 590



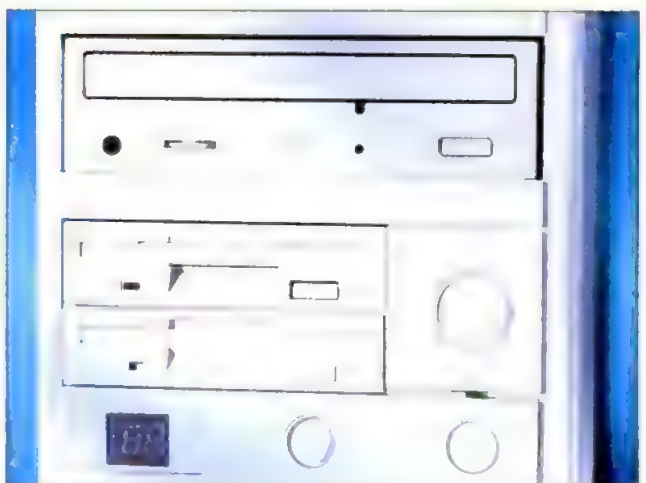
Halfway there. The keyboard and mouse ports are labeled clearly enough, but why are the rest printed in an unintelligible beige-on-beige tone?



AMAX 90 PowerStation



PCMCIA "drives." PCMCIA slots make it easy to interchange data with notebook computers and add only about \$100 to the system's cost. Of course, you'll need a PCMCIA flash card or hard disk.



Comtrade PCI CAD/Publishing 590



Faux faceplate. Two 3.5-inch floppy disk drives? Not quite. The lower faceplate is just a facade—one you'll quickly come to hate after a few abortive attempts to insert a disk.

THE ETHERNET+MODEM II.



PLUG IN. LOG ON. DIAL OUT.

Introducing the one card that does it all—from anywhere in the world. The amazing, all new Xircom CreditCard Ethernet+Modem II.

Just plug it into your notebook and you can log on to any Ethernet LAN on any network operating system anywhere. Or dial into any online service. Or access any E-Mail system. Or BBS. On this continent. Or any other.

You see, the Ethernet+Modem II is the first true international modem, with communications software that can be configured on a country-by-country basis.



The Ethernet+Modem II sends data at speeds of up to 19.2 Kbps with full error correction and data compression. It comes with its own data and fax communications software for DOS or Windows. And it's bundled with Traveling Software's LapLink® for Windows so it can provide remote control and file transfer for mobile workers.

It's also cellular capable to take advantage of wireless connections. And best of all, it's the first adapter to provide simultaneous LAN and fax modem capabilities through just one slot. (The combination Ethernet+Modem II has connections for both 10Base-T and 10Base-2.)

Like all of our adapters, the Ethernet+Modem II comes with a lifetime warranty from Xircom, the leader in mobile networking. The company with more notebooks connected to more LANs than all other vendors combined.

And right now through January 31, 1995, you can get the new Ethernet+Modem II for just \$499*. To take advantage of this great deal, simply give us a call at 1-800-438-4526 ext. 40B.

Then plug in, log on and dial out.

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CIRCLE 211 ON READER SERVICE CARD

WHAT TO BUY

Here's what goes into a great PC.

To get the PC with the best price and performance, you need the right vendor and components. Our recommendations assume you're running Microsoft Windows and are considering upgrading to Microsoft Windows 95 next year. For a look at the relative prices and performance of the 165 PCs in this issue, see the other side of this foldout.

Processor (CPU) Range Most entry-level PCs use Intel's 486DX2/66 processor. (You can buy PCs with slower, 33-MHz 486 CPUs—but you won't save much money.) Most midrange PCs use Intel's DX4/100, Pentium/60, or Pentium/66; all three CPUs offer about the same level of performance. High-end PCs use the Pentium/90 and operate roughly twice as fast as entry-level PCs. You can also buy systems with CPUs from AMD, Cyrix, and IBM that are Intel-compatible; currently, they perform on a par with entry-level Intel CPUs. We don't believe compatibility is a problem. Recommendation: Pentium/90.

Processor Cache The processor cache (also known as external cache, secondary cache, or L2 cache) can speed up performance by 10 percent. We recommend 256K (128K minimum).

Memory (RAM) Adequate memory can improve Windows application performance by 25 percent or more. Only having 4MB, however, is not adequate. The sweet spot is between 8MB and 12MB. If you're running multiple applications, 16MB makes sense.

Disk Drives Hard disk capacity is cheap at 50 to 75 cents per megabyte. Get at least 340MB—preferably 520MB—to handle today's big applications. A 1GB hard disk is not unreasonable. IDE hard disks are faster under Windows than SCSI hard disks. Get a double-speed CD-ROM drive, to install applications if nothing else.

Graphics Get an accelerated, 64-bit local-bus graphics adapter with 1MB to 2MB of VRAM (4MB for higher-end graphics work). At minimum, get a 15-inch monitor (not a 14-inch model); to run multiple applications simultaneously, get a 17-inch monitor capable of 1,024-by-768 resolution at 75 Hz.

Case Design, Internal Capacity Mini-towers are the most versatile. Desktop cases provide adequate expansion space for most users. Slimline cases offer fewer slots and bays than many desktop cases and may limit future expansion. Tower cases are overkill for many.

Expansion Bus The best bus is a combination of a PCI local bus for graphics adapters and disk controllers and ISA for slower add-on devices. VL-Bus is adequate for 486-based PCs, but the standard is dying. Avoid VL-Bus/PCI combinations, because they exact a performance penalty. EISA is offered in some high-end systems, but it is mostly found in file servers.

Multimedia In addition to the CD-ROM drive, get a 16-bit sound card with wavetable (not just FM) sound synthesis. Upgrade to higher-quality speakers (most are tinny-sounding).

Miscellany Insist on flash BIOS and a high-speed serial port with a 16550 UART chip. Have all accessories installed when you buy your PC to eliminate installation hassles.

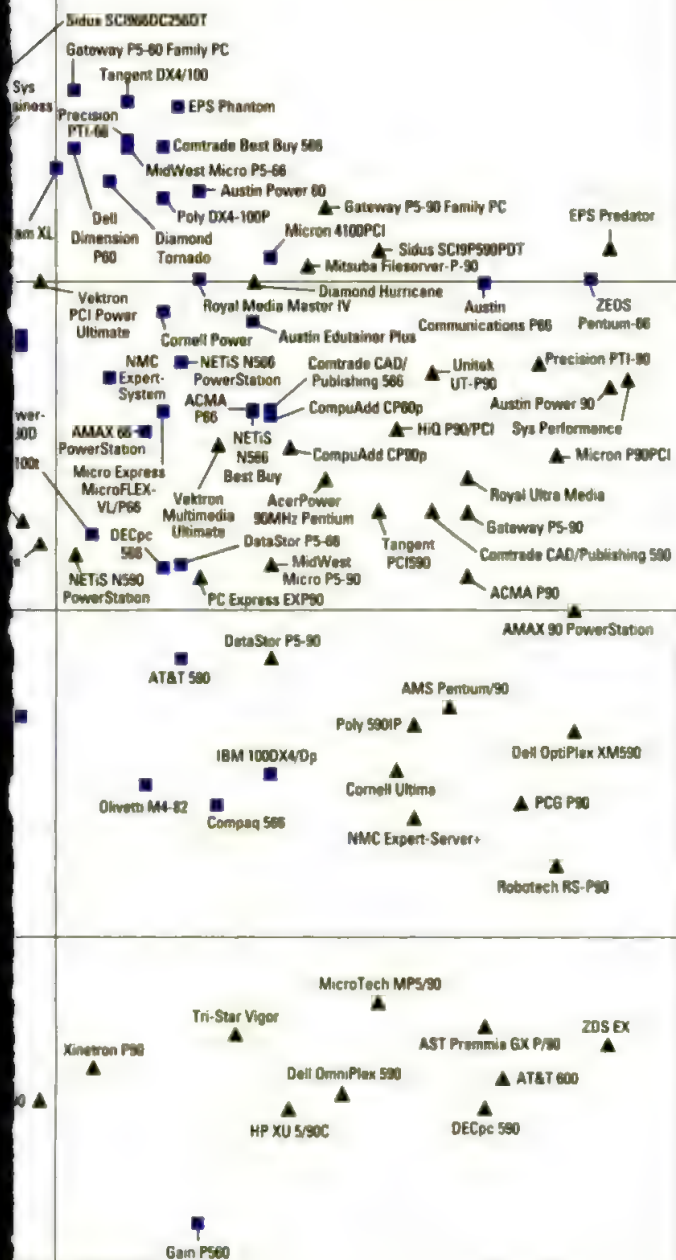
Service & Reliability Vendor warranties range from one to three years or more on parts and labor. Some offer on-site service standard; others, for an extra fee. See if the vendor offers 24-hour, seven-day toll-free technical support; also check for an on-line bulletin board (such as on CompuServe) where you can ask questions.

Where to Buy Once you're ready to purchase your PC, you'll need to decide where to buy. For a wide selection of custom configurations, look to *direct vendors*. If you want to test-drive your system before purchasing, consider a *computer retailer* (though they tend to charge higher prices). *Superstores* often have a wide selection of PCs from many different vendors, but the salespeople may lack computer knowledge. For a total solution—including hardware, software, and a customized network—a *value-added reseller* or consultant may be what you want.

Price The systems we tested for this feature ran the pricing gamut—from a low of \$1,495 for a 486DX2/66-based system to a high of nearly \$6,000 for a Pentium/90 unit. On the average (based on our test configurations), you can expect to pay roughly \$2,000 for an entry-level system, \$3,000 for a midrange unit, and \$4,000 for a 90-MHz Pentium PC.

MOST BANG FOR THE BUCK

- ▼ Entry-level
- Midrange
- ▲ High-end



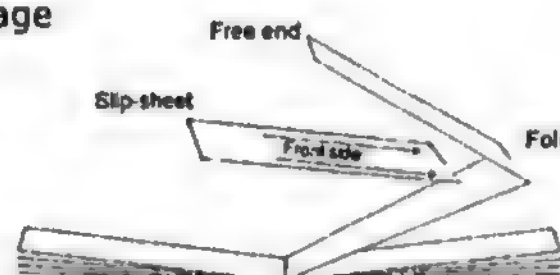
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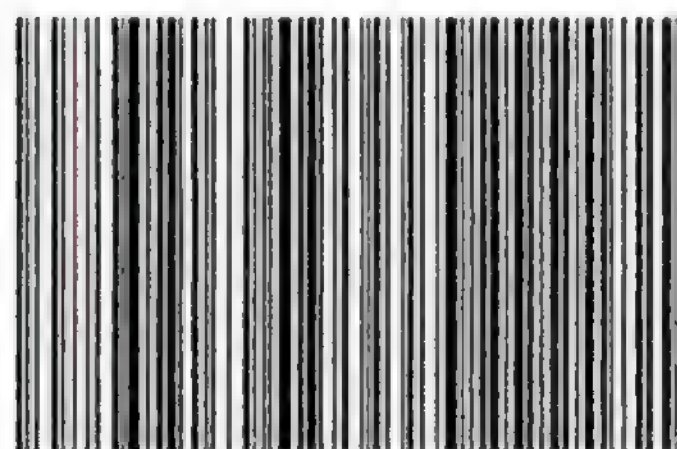
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performance and features

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2. Insert this sheet with
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 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet



Inverted Foldout slip-sheet

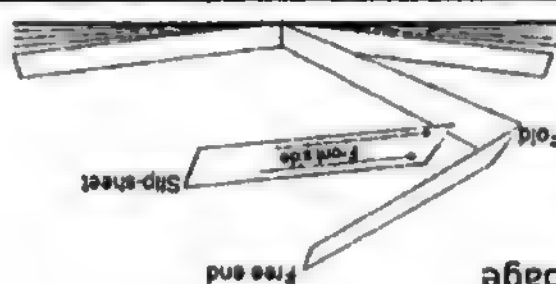
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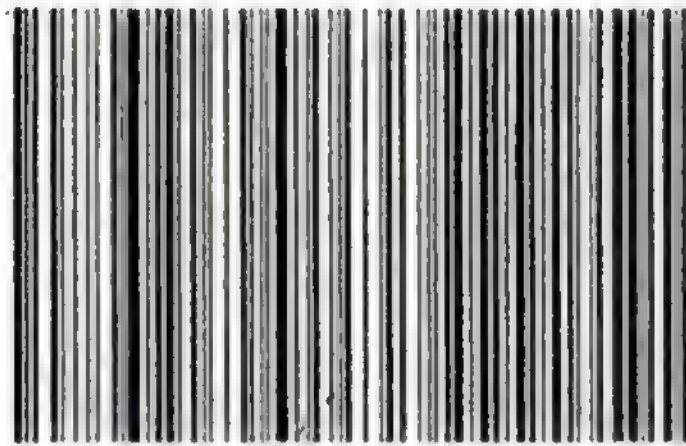
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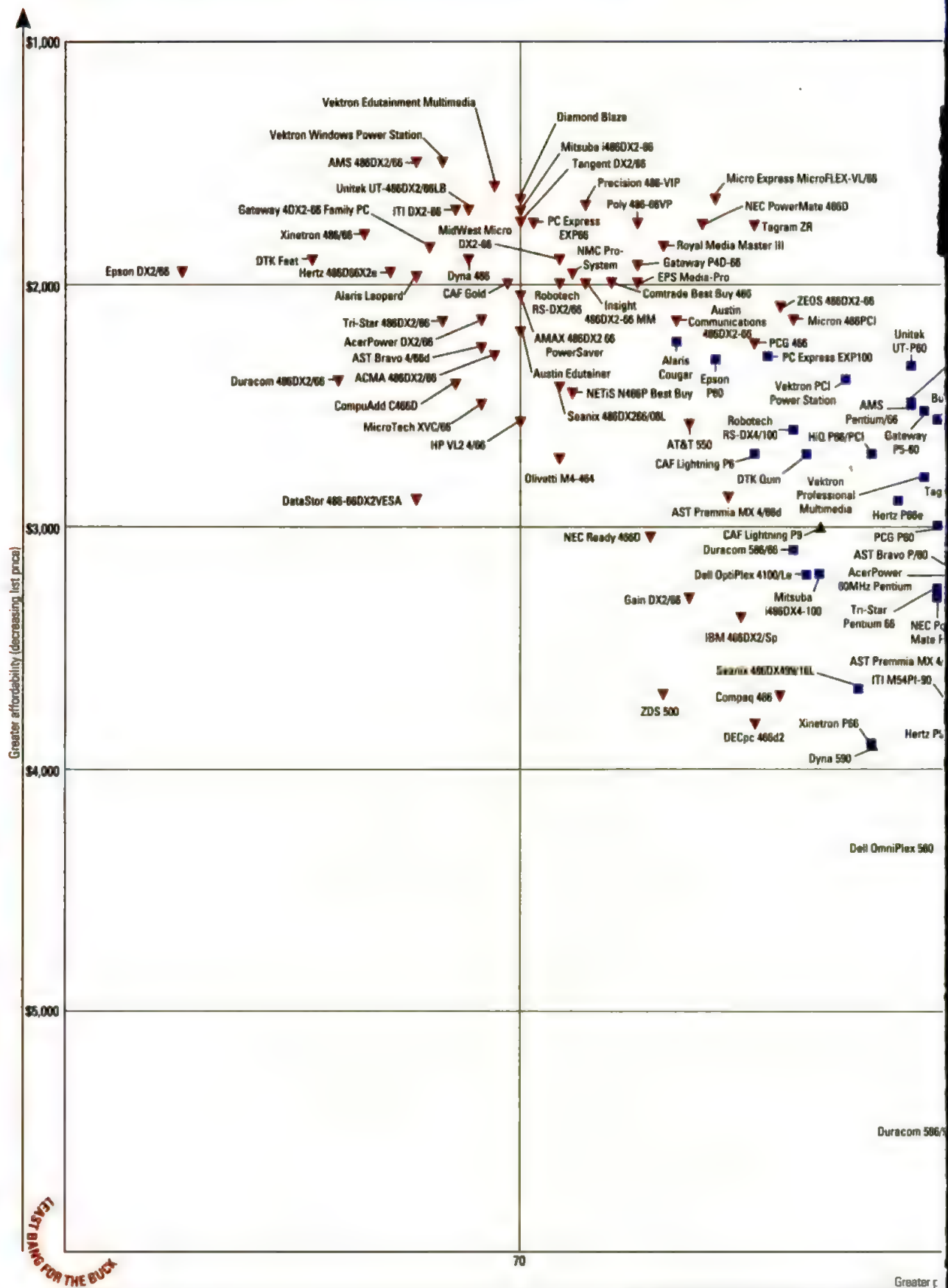
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Back

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▪ Price/Performance Index: *Pentium and 486 PCs*

Few product lines fared as well in our price/performance index as the ZEOS Pantera family. Both Pentium-based Pantera systems managed price/performance showings that landed in the top ten; the entry-level ZEOS Pantera 486DX2-66 was closer to the middle of the pack. A major factor in the Pantera units' success was their outstanding Winstone 95 scores: The Pentium machines produced first-place scores in their respective tiers, and the ZEOS 486DX2-66 earned a top-five ranking among the entry-level systems.

Dell Computer Corp. and EPS Technologies also earn kudos for their Dimension and Dominator lines. All five systems in these two product families placed among the top 25 percent of systems in our index. The EPS systems earned this honor with average to above-average benchmark test scores and excellent prices. The Dimension systems were also priced below average for their respective groups, but excellent expandability, a three-year warranty, and 24-hour daily telephone support (not to mention an above-average Winstone score for the Dell Dimension XPS P90) pushed each system toward the top.

For the best value overall, look to Micro Express, whose entry-level MicroFLEX-VL/66 managed the most impressive price/performance showing. The system earned this honor by combining the fourth-lowest price tag with competitive performance.

Two more entry-level systems finished in second and third place: the Tagram Thunderbolt ZR and NEC PowerMate 466D. Both systems are priced at barely \$100 more than the Micro Express MicroFLEX-VL/66, and both posted mostly above-average marks on our benchmark tests. The Tagram system set itself apart with the

highest Winstone score of the low-end systems.

These three systems aren't the only entry-level PCs with high price/performance ratios. In fact, among the units in the top third of this index, entry-level systems formed the majority. This is explained in one word: price. You have to wade through nearly 40 of the least expensive systems before you find one that isn't an entry-level PC. The trade-off is performance. Though many of these systems will give you satisfactory performance, the entry-level systems performed poorly compared with the other systems in this roundup. Entry-level systems comprised the entire bottom quarter of our performance/features results, and the best entry-level system, the Micron 466PCI Magnum, easily placed in the lower half in terms of performance.

If speed is most important, look no further than Insight Direct, whose Insight PCI P90 MM and Insight PCI P66 MM managed first- and third-place performance/features scores, respectively. Besides managing average to above-average performance,

each Insight system features superior expandability, a 17-inch monitor, a 14.4-Kbps fax modem, and a complete multimedia package. Price tags of \$4,799 for the Insight P90 and \$3,999 for the Insight P66 make these systems among the most expensive in their respective tiers and leaves them in the middle third of our price/performance index.

The Editors' Choice winner from our most recent desktop roundup (September 27, 1994), the HP Vectra XU 5/90C, didn't fare as well in this roundup. In this go-around, its SCSI-2 hard disk subsystem couldn't keep up with the competition, most of which used Enhanced IDE-based systems. The result was below-average benchmark test scores for the HP XU 5/90C practically across the board.

Other systems that didn't fare well include the Gain Master P560, a midrange PC with the highest price of the lot, and the Duracom FilePro 586/90 and Xinetron X/LAN P90, both high-end systems with well above-average prices.—*Analysis written by Jodi L. Wynblatt and Mary E. Behr*

The Data Points

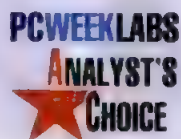
Benchmark test results account for 60 percent of each system's combined performance/features score. Features account for the remaining 40 percent. Monitor size and installed hard disk size each account for 5 percent, and each of the following account for another 3 percent: CD-ROM speed, maximum RAM supported, number of available drive bays, and number of available expansion slots. The presence of a sound card, a network adapter, a removable hard disk, an enhanced parallel port, flash BIOS, and a 16550 UART chip account for nearly 6 percent of each system's score. Energy Star compliance, data and fax transfer rates for the installed modem, maximum external cache supported, warranty length, telephone support, on-site service, and the number of mouse, parallel, serial, and SCSI ports account for just over 12 percent. For more information, look in the Hardware Library of the Editorial Forum on PC MagNet under 21BANG.XLS.

THE 5 POINT PENTIUM CHECKLIST



June 26, 1994
Micron P90PCI POWERSTATION

"The system's components and general design dazzled under Windows."



June 27, 1994
Micron P90PCI POWERSTATION

"This machine offers the best available combination of price and performance."



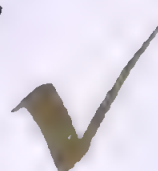
September, 1994
Micron P90PCI POWERSTATION

"Outfitted to the nines for the most demanding business applications."



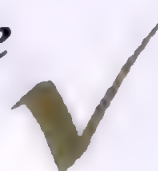
October, 1994
Micron P90PCI POWERSTATION

"Micron serves up a feast for the power hungry with its new Pentium-90."



July 1994

The highest ratings available in four categories for 1994.



MICRON

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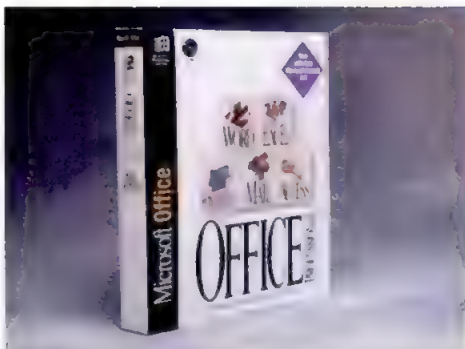
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Autodesk

Micron's P90PCI is engineered to provide the highest performance for your most demanding CAD applications. Applications such as AutoCAD, AutoVision, and 3D Studio. From the pioneer and market leader in supplying CAD software for the desktop—Autodesk—providing an arsenal of design and engineering power when matched with Micron's super-charged workhorse, the P90PCI. With the P90PCI, experience CAD capabilities and functionality that were once available only in high-end environments. That's because Micron delivers tightly integrated system solutions and a wide range of system configurations that ideally match your needs and are aimed at greatly increasing your productivity. CAD with power to spare. See for yourself why *PC World* said, "Micron serves up a feast for the power hungry with its new Pentium-90."

The calculated match . . . Autodesk and Micron's P90 Pentium performers.



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Microsoft Office

Look to Micron's versatile P90PCI and Microsoft Office Professional for a completely integrated and extremely powerful office solution. Thanks to Micron's P90PCI Pentium performance and Microsoft's intuitive OfficeLinks tools, it's easy and fast to share text, data and graphics seamlessly between the suite of best-selling products that make up Microsoft Office—Microsoft Word, Microsoft Excel, Microsoft Access, Microsoft Powerpoint and Microsoft Mail. See how the powerful P90PCI makes easy work of creating spreadsheets, charts, graphs, and presentations. And at a super-low price point that is turning the critics' heads. That's why *PC Week* said "the P90PCI PowerStation offers the best available combination of price and performance."

The integrated match . . . Microsoft Office and Micron's P90 Pentium performers.



GRAPHICS

Fractal Design

Painter 3

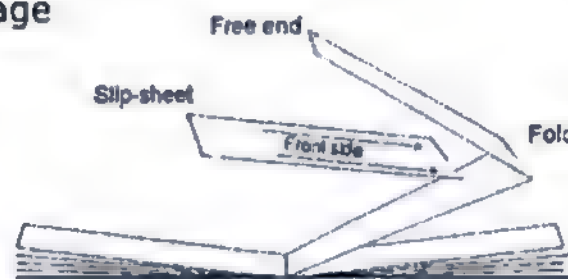
Matched with the awesome performance of Micron's P90PCI, Fractal Design Painter 3, with 50 new and exciting features, allows you to stretch your imagination and take full advantage of Painter 3's patented *Natural-Media*® creative technology. The processing power of the Micron P90PCI makes easy work of your most demanding imaging projects. And with a wide range of system configurations to choose from, our reputation as a high quality provider of reliable systems, and the lowest prices anywhere, Micron makes selecting your P90PCI an enjoyable experience. We back that up with a 30-day money back guarantee and a full one-year warranty on the entire system, including the monitor! According to *PC World*, our customers are more likely to purchase a Micron computer again than any other manufacturer. Need we say more?

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Foldout slip-sheet



GbsSlipSheet-001

Inverted Foldout slip-sheet

Folded edge of the page

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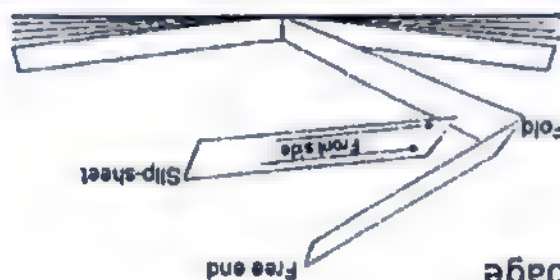
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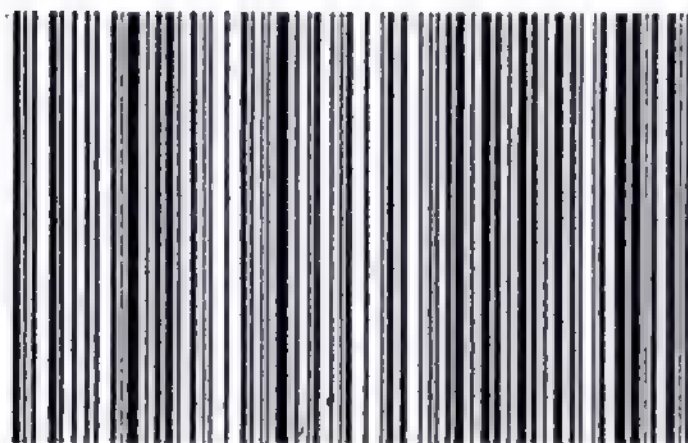
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Gbs5lipBack-001B

Back

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THE P90 HOME MPC

Pentium Power



The days are gone when a 486 PC was sufficient for home use. Now, by the time mom and dad get their spreadsheet and graphics packages loaded, and the kids cram on their educational software and arcade-quality multimedia games, your PC is crying out for more horsepower. Micron provides you an attractive alternative—the Micron P90 Home MPC, with 90MHz of Pentium performance at 486 prices. And on top of that, we include the SoundBlaster 16 sound card, speakers, joystick, CD-ROM drive and fax/modem—plus a wide variety of home productivity and entertainment software on CD. Don't settle for less than a Micron P90 Home MPC.

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NETiS Technology Inc.

• NETiS PowerStation

For the business buyer, NETiS Technology offers its PowerStation line of PCs, represented here by the 90-MHz Pentium-based NETiS N590 PowerStation (\$3,830) and the 66-MHz Pentium-based NETiS N566 PowerStation (\$3,250). (For home users, the company also offers its NETiS Best Buy line, which we review separately.) These systems are well-priced, considering the components each includes.

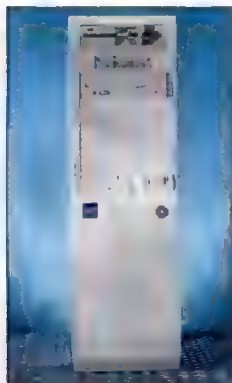
Both came loaded with NEC Multi-Spin triple-speed CD-ROM drives, ATI Graphics Pro Turbo cards with 2MB of VRAM, and Adaptec SCSI controllers for their CD-ROM and hard disk drives (a 515MB disk for the N566 and a 1GB disk for the N590).

The two units further differ in that the

IN SHORT

NETiS PowerStation

Reasonable performers geared toward business users.



N566, which comes in a desktop case, utilizes an ISA/PCI bus design; the N590 is housed in a tower case and has ISA, PCI, and VL-Bus slots. One unfortunate similarity between these units is their lack of integrated I/O. Not only does this situation require the use of one ISA slot in each system for an I/O and floppy controller card, but each unit

loses another ISA slot, because the I/O ports are routed through its backplate. The N590 uses an OPTi chip set that we've found introduces timing delays in PCI bus transfers. This partially explains the unit's below-average performance and the fact that the N566 outperformed its 90-MHz sibling on our Windows-based tests. The N566 uses Intel's Mercury chip set; its test scores ranged from average to above average under Windows.—CAV

► **NETiS Technology Inc.,** Milpitas, CA; 800-577-7526, 408-263-0368; fax, 408-263-4624.

Circle 478 on reader service card

Olivetti North America

• Olivetti Modulo

Olivetti's Modulo line of machines are a breeze to open and to service, but their performance was unimpressive, and their prices are relatively high. The \$4,537 Olivetti M4-82, a Pentium/60-based machine, had mixed results on our Windows-based tests, with test scores that ran the gamut from below to above the midrange system averages. The \$2,718 486DX2/66-based Olivetti M4-464 was an average performer in its class.

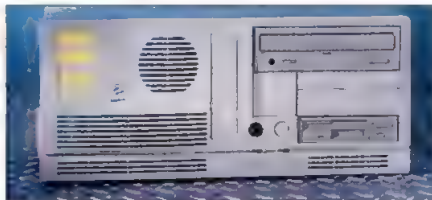
The Modulo line, aimed at large businesses, is designed with ease of service in mind. Opening a Modulo consists of twisting two folding keys on the sides, sliding the lid toward the front, and lifting it up. Inside, a hinged drive bay/power supply assembly swings out of the way to provide open access to the motherboard.

With its expansion slots on a riser board and its I/O ports, video subsystem, and floppy and hard disk controllers all integrated on the motherboard, the VL-Bus-based M4-464 offers a neat interior lay-

IN SHORT

Olivetti Modulo

Easily serviced business PCs lacking competitive pricing and performance.



out with no obstructions. The M4-82 uses a more conventional motherboard and came with a Matrox graphics board installed in one of three PCI slots. Two of five ISA slots were partially blocked by a high heat sink on the CPU.

The M4-82's Winstone 95 score was average, its Disk WinMark 95 score was above average, and its Graphics WinMark 95 score was below average compared with other midrange systems. The M4-464 posted average scores for its class across the board, except for a below-average Disk WinMark score.—RSA

► **Olivetti North America,** Liberty Lake, WA; 800-633-9909, 509-927-5600; fax, 509-927-5700.

Circle 479 on reader service card

PC Express Inc.

• PC Express

PC Express emphasizes service—and to that end, it offers a four-year warranty with on-site service included for one year. The company's prices are also attractive: \$1,749 for the PC Express EXP66, a 486DX2/66 VL-Bus/ISA desktop; \$2,299 for the PC Express EXP100, a DX4/100 VL-Bus/ISA mini-tower; and \$3,899 for the PC Express EXP90, a 90-MHz Pentium PCI/ISA tower unit with a standard 17-inch Nokia monitor. The downside is average to below-average performance.

The EXP66 unit managed a Winstone 95 score just above the average compared with other entry-level systems. The EXP66 also performed competitively across the remainder of our tests, garnering average scores on the other Windows-based tests and an above-average score on our DOS Video tests. The EXP90 had an average score on the Winstone and Disk WinMark 95 tests, but its Graphics WinMark 95 score was below average. The EXP100 was not a strong performer under Windows, garnering below-average scores on the Winstone and Graphics WinMark tests.

Some test scores may be explained by the systems' components. The EXP66, with a Tseng-based Hercules graphics card with 1MB of DRAM, did well among the entry-level units. But the EXP100, equipped with the same card, and the EXP90, using the Diamond Viper card with a Weitek P9000 chip set and 2MB of VRAM (both 32-bit graphics accelerators), had trouble beating systems equipped with newer, 64-bit chips.—AY

► **PC Express Inc.,** Richfield, MN; 800-937-1100, 612-861-5555; fax, 612-861-5701.

Circle 480 on reader service card

IN SHORT

PC Express

Lackluster performers distinguished only by long warranties.



Personal Computer Graphics Corp.

● PCG BurStar

Personal Computer Graphics Corp. took a unique approach to pumping up the performance of its machines—and not one that we recommend. Two of the three PCG BurStar machines that the company submitted were running at higher clock frequencies than their main processors were rated to handle. The \$4,587 PCG BurStar P90, based on a 90-MHz Pentium processor, ran the processor clock at 100 MHz; the \$2,247 PCG BurStar 466, which uses an Intel 486DX2/66 processor, was running at 80 MHz. Inside the two machines were an assortment of unusual wires and hand-soldered components. Only the Pentium/60-based PCG BurStar P60 (\$2,997) appeared to be operating within its recommended limits.

The BurStar systems had a fairly typical set of components, although all three systems used SCSI-2 hard disks. (Interestingly, the entry-level 466 is the only one with an integrated SCSI port.)

We don't report benchmark test results for the 466 and P90, because we don't consider it meaningful to compare hot-rodded systems against machines running within their specs. The P60 posted performance results that were average for midrange systems.

We wouldn't buy the overclocked BurStar systems to put on our own desktops; even with the pushed clocks, their overall performance was good but not exceptional. In any case, we have serious doubts about the reliability of the systems. Caveat emptor.—RSA

► **Personal Computer Graphics Corp.,** Santa Monica, CA; 800-255-9893, 310-452-8470; fax, 310-392-9033.

Circle 481 on reader service card

IN SHORT
PCG BurStar
*Overclocked CPUs
raise reliability
concerns; not
recommended.*



Polywell Computers Inc.

● Polywell Poly

Rather than send three nearly identical systems for review, Polywell Computers provided systems aimed at three distinct market segments. For the home user, Polywell offers the \$1,750 Poly 486-66VP—a small-footprint, DX2/66-based ISA/VL-Bus/PCI system. For business buyers looking for a bit more power, Polywell has the \$2,750 Poly DX4-100P, a DX4/100-based ISA/PCI mini-tower PC. At the high end—aimed at power users looking for a CAD, imaging, or engineering workstation—is the \$4,350 Poly 590IP, a 90-MHz Pentium-based ISA/PCI system.

All three Polywell systems performed very competitively within their respective tiers, and all are well priced. Although the 590IP is more expensive than the average Pentium/90 system in this roundup, its price includes a 1.1GB SCSI-2 hard disk and an ATI Graphics Pro Turbo graphics adapter with 4MB of VRAM.

The three Polys are cleanly designed. All cabling is tie-wrapped, and all ports are labeled. The DX4-100P and the 590IP both have integrated I/O; the 486-66VP relies on a VL-Bus card to control I/O ports, the floppy disk drive, and the hard disk.

The Polys produced roughly average scores on all of our benchmark tests, except for a below-average showing for the DX4-100P on our CPUmark₁₆ tests. The 486-66VP's scores were slightly above average on our

IN SHORT
Polywell Poly
*Well-priced,
competitive systems
targeting all types of
users.*



Windows - based tests.

Polywell includes a two-year parts, five-year labor warranty with its systems, as well as an excellent owner's manual.—CAV

► **Polywell Computers Inc.,** South San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974.

Circle 482 on reader service card

Precision Technology Inc.

● Precision Premium

Precision Technology's entry into our roundup consisted of three desktop systems: the \$1,675 486DX2/66-based Precision 486-VIP, the \$2,575 66-MHz Pentium-based Precision PTI-66, and the \$3,250 90-MHz Pentium-based Precision PTI-90. These units, mostly sold directly to corporate, government, and educational sites (some units are also sold through resellers), are attractive mainly because of their prices, which include 17-inch ViewSonic monitors. Each of the two Pentium systems also comes with an NEC Multi-Spin triple-speed CD-ROM drive; the 486-VIP contains a Sony CDU 33A double-speed CD-ROM drive and a SoundMedia sound board.

The 486-VIP uses both PCI and VL-Bus slots, while the PTI-66 and PTI-90 both use a PCI design. All units have free drive bays available in their desktop cases and plenty of free slots. But the 486-

IN SHORT
Precision Premium
*Attractively priced
business systems
with uneven
performance.*



VIP's expandability is limited by its motherboard design: Two ISA slots and one PCI slot will not take full-length cards, because of the placement of the CPU/fan assembly.

The performance of the three units varied widely. The 486-VIP produced below-average scores in the entry-level group on our Winstone 95 tests. The PTI-66's scores were average for its group on all Windows-based tests; on the DOS side, it produced slightly above-average numbers on the DOS Disk and CPUmark₁₆ tests, but its DOS Video score was below par. The PTI-90 garnered average to above-average scores on all tests, marked by a strong score on the DOS Disk tests.—CAV

► **Precision Technology Inc.,** Fremont, CA; 800-783-2466, 510-657-9811; fax, 510-657-0892.

Circle 483 on reader service card

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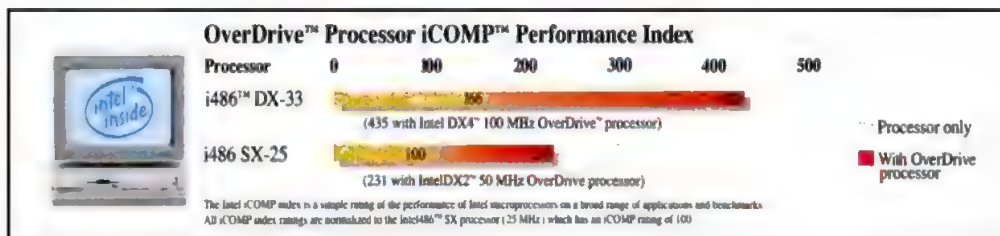
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CIRCLE 363 ON READER SERVICE CARD

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Robotech Inc.

• Robotech Cobra RS

The Cobra RS series from Robotech—a newcomer to *PC Magazine*—gives you a lot of machine for your money. The \$4,779 90-MHz Pentium-based Robotech Cobra RS-P90 (a mini-tower system) and the \$2,599 DX4/100-based Robotech Cobra RS-DX4/100 and \$1,999 DX2/66-based Robotech Cobra RS-DX2/66 (desktops) are bundled with an arsenal of software and peripherals that would warm the fingers of any serious game maven or power-application user.

The PCI-based RS-P90 is designed as a serious high-end business machine. It came with a massive (\$1,399) 20-inch Tatung monitor, a quadruple-speed Plextor CD-ROM drive, Yamaha YST-M10 speakers, a Creative Labs Sound Blaster 16 sound board, a large Suncom joystick, a Genoa

Systems Phantom graphics board, and a large selection of disk- and CD-ROM-based software.

The entry-level RS-DX2/66 and midrange RS-DX4/100 came with similar software bundles but offered more pedestrian 14-inch Cobra RS Multi-Scan monitors, double-speed CD-ROM drives, and smaller hard disks and speakers.

Rather than PCI, they used VL-Bus.

The RS-P90 posted one of the top Winstone 95 scores in this entire roundup and turned in average scores for its tier on all the other tests. The RS-DX4/100 turned in a Winstone score that was average relative to other midrange systems, although its scores on other tests tended to be below average. Performance of the RS-DX2/66 was average across the board within its tier.—RSA

► **Robotech Inc.**, Midvale, UT; 800-533-0633, 801-565-0645; fax, 801-565-0680.

Circle 484 on reader service card



Royal Computer Inc.

• Royal Media Master

Royal Computer sells PCs to professional, high-end graphics users in the home, business, and government markets. We tested three ISA/PCI-based Royal systems: the \$1,845 Royal 486/66 Media Master III; the \$2,995 Royal P/66 Media Master IV; and the \$3,595 Royal P/90 Ultra Media. All the systems are priced competitively, but performance varies: While the two Pentium units were strong Windows performers, the 486DX2/66 unit could not keep pace with its competition.

The Ultra Media is the most attractively configured system of the line: Its price includes a 17-inch monitor, an NEC Multi-Spin triple-speed CD-ROM drive, a Sound Blaster 16 audio card, and an assortment of software titles. The Media Masters both came with 15-inch monitors and Orchid SoundWave 32 audio cards, but the Pentium/66 unit also had an NEC triple-speed CD-ROM drive, while the 486DX2/66 model used a double-speed drive.

The three systems have mini-tower cases. The Media Masters use an I/O and floppy controller card, and both lose an additional ISA slot because the I/O ports run out the back of the neighboring slot.

On our tests, the two Pentium units were competitive performers in their respective tiers. Both produced Windows-based test scores that were on a par with or above their groups' averages. The 486DX2/66 posted an average Winstone 95 score and garnered slightly above-average Graphics WinMark 95 and Disk WinMark 95 scores.—CAV

► **Royal Computer Inc.**, City of Industry, CA; 800-486-0008, 818-855-5077; fax, 818-330-2717.

Circle 485 on reader service card

IN SHORT Royal Media Master

These well-priced Windows workstations come loaded with lots of extras.



Seanix Technology Inc.

• Seanix ASI 9000

In a field of similarly configured PCs with familiar, off-the-shelf components, Seanix Technology (of Vancouver, Canada) offers something a little less pedestrian with its DX4/100-based \$3,670 Seanix ASI 9000 486DX499/16L and \$2,425 Seanix ASI 9000 486DX266/08L mini-tower PCs. Neither machine was an outstanding performer on our tests, but both offer reasonable value and performance compared with systems at the same level.

Seanix, which sells mainly to small businesses and home users, incorporates much of its own technology into its machines. For example, both ASI 9000 PCs use a Seanix-built all-in-one board, the ASI Rocket-VL, that includes a video subsystem with a Western Digital 90C33-22 chip set and 1MB of DRAM (upgradable to 2MB).

Though we expected subpar video performance scores from machines outfitted with such a multifunction expansion board, both machines yielded respectable though not outstanding scores on the Graphics WinMark 95 and DOS Video tests for their respective groups. The 486DX266/08L also posted above-average Disk WinMark 95, DOS Disk, and DOSmark scores among the entry-level systems.

Aside from the multifunction VL-Bus card, a CD-ROM interface card occupies an ISA expansion slot in each Seanix machine. This setup leaves one VL-Bus slot, one 8-bit ISA slot, and three 16-bit ISA slots available on each system's motherboard.

► **Seanix Technology Inc.**, Richmond, British Columbia, Canada; 604-273-3692; fax, 604-273-0749.

Circle 486 on reader service card

IN SHORT Seanix ASI 9000

Small-business and home-user systems with reasonable performance.



Sidus Systems Inc.

• Sidus Formula

The Sidus Formula series of desktop machines from Sidus Systems is made up of PCs with familiar, brand-name components and few surprises. The Pentium/90-based Sidus Formula SCI9P590PDT and DX4/100-based Sidus Formula SCI966DC256DT are competitively priced at \$2,902 and \$2,490, respectively. The Pentium system proved to be a Windows-performance powerhouse; the DX4 unit wasn't such a star, but performed within its group's average.

The two systems share the same type of case. The units have different motherboards, but both integrate I/O, floppy disk, and local-bus IDE hard disk controllers.

The Pentium-based machine offered one shared ISA/PCI slot, plus four ISA and two PCI slots; the DX4 unit had five ISA and two VL-Bus slots. In both systems one ISA slot was used by a CD-ROM interface board, and a local-bus slot held an ATI graphics board (the Pentium/90 machine used a 64-bit PCI card, while the DX4 system used a VL-Bus-based 32-bit card).

The Pentium unit proved to be a powerful Windows performer, earning one of the highest Winstone 95 scores in this roundup and outdistancing most other high-end systems by a comfortable margin. The unit posted average scores within its group on all other tests, except for the Disk WinMark 95 tests, where it was just above average. The DX4 machine achieved average scores on all measures except the Graphics WinMark 95 tests, where it fell below the average for its tier.—RSA

► **Sidus Systems Inc., Richmond Hill, Ontario, Canada;**
800 - 856 - 3667,
905 - 882 - 1600;
fax, 905 - 882 -
2429.

Circle 487 on reader
service card



Sys Technology Inc.

• Sys Business and Performance Series

Sys Technology chose to focus its efforts on Pentium systems for our review. The Sys Business P66 and the Sys Performance P90 that we tested were average to above-average performers on our tests, and their prices—\$2,559 for the Business desktop and \$3,299 for the Performance mini-tower—are very competitive.

Both units are based on an ISA/PCI bus design. The Performance (a tower

version of which received our Editors' Choice award in our issue of September 27, 1994) came loaded with a 1GB hard disk attached to a Bus-Logic PCI-based 8MB caching disk controller. The Business included a 503MB hard disk and a cacheless DTC PCI-based disk controller. Neither system has integrated I/O or floppy disk controllers, so both rely on ISA cards to do the job. Though this does not affect performance, it does affect the potential for expanding these units: One PCI slot in each machine was not usable, because an I/O port used a PCI slot's backplate.

Both Sys entries were solid performers on all of our tests. On the Windows side, the Performance and the Business both turned in solidly average scores within their respective tiers on the Winstone 95 and Disk WinMark 95 tests. On the Graphics WinMark 95 tests, the Performance's score was slightly above average, while the Business's score was average within its group. Under DOS, both systems performed extremely well, producing above-average scores on our DOSmark tests.—CAV

► **Sys Technology Inc., Los Alamitos, CA;**
310-493-6888; fax, 310-493-2816.

Circle 488 on reader service card



IN SHORT

Sys Business and Performance Series

Competitively priced business workstations with average performance.

Tagram System Corp.

• Tagram Thunderbolt

Tagram System Corp., which primarily targets corporate and government buyers and end users, sent two ISA/VL-Bus representatives of its computer line for our roundup: the \$2,659 Tagram Thunderbolt XL, with a DX4/100 CPU and a standard-issue quadruple-speed CD-ROM; and the 486DX2/66-based \$1,759 Tagram Thunderbolt ZR. The two systems, particularly the ZR (which tied for first in the entry-level group on our Winstone 95 tests), were good performers in their classes.

The two systems were highly integrated—particularly important for the ZR, which came in a slimline case. VL-Bus video and hard disk controllers were integrated on the motherboard, as were I/O and floppy disk support. The ZR left two drive bays, one VL-Bus slot, and three of four ISA slots open in our tested configuration. The system's slots are on a riser card, and one of the ISA slots is blocked by the connectors for the hard disk and floppy disk controllers. The XL also uses a riser card for expansion slots, but its mini-tower case gives you easier access to components and more room to grow.

The performance of the ZR was outstanding on our Windows- and DOS-based tests. It had the best Disk WinMark 95 and DOSmark scores in its class, as well as the highest Winstone score (tied with the NETiS N466PBest Buy). The XL

was also a competitive performer: It managed an average WinMark score within its class and an above-average Disk WinMark score, but scored below average on the Graphics WinMark 95 tests.—AY

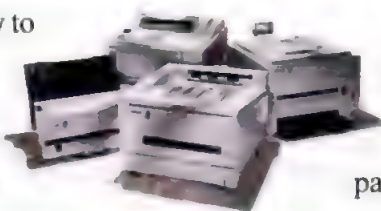
► **Tagram System Corp., Tustin, CA;**
800 - 824 - 7267,
714-258-3222; fax,
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Tangent Computer Inc.

• Tangent Desktop

Tangent Computer's PCs aren't limited to a single family; the company sells everything from file servers to some of the first desktop systems based on NexGen's new 586 processor. (See the sidebar "100 MHz and Beyond" for results of performance testing of prototype NexGen-based machines.) For this review, we tested members of Tangent's Intel-based desktop PC line: the \$1,745 ISA/VL-Bus-based Tangent DX2/66; the \$2,459 Tangent DX4/100, which also uses an ISA/VL-Bus combination; and the \$3,695 ISA/PCI-based Tangent PCI590.

Although these units are priced lower than much of the competition, they include some nice extras. The PCI590 and DX4/100 come in identical, "no tools" cases—just loosen one thumbscrew and the cover slides off. A Diamond Stealth 64 with 2MB of VRAM powered the graphics subsystem in the PCI590 and the DX4/100, while the DX2/66 used an Ark 1000VL with 2MB of DRAM. Tangent backs these systems with a one-year warranty and ships them with a comprehensive user guide.

On our benchmark tests, the Tangent systems were competitive performers within their respective

IN SHORT

Tangent Desktop

Attractively priced general-purpose machines that deliver on performance.



classes. All three posted average to above-average scores across the board. The Pentium/90 unit was particularly strong overall: It posted above-average scores within the high-end group on the Disk WinMark 95, DOS Disk, DOS Video, and DOSmark tests and came in slightly above average on the Graphics WinMark 95 tests.—CAV

► **Tangent Computer Inc., Burlingame, CA;** 800-800-5550, 415-342-9388; fax, 415-342-9380.

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Tri-Star Computer Corp.

• Tri-Star Tri-CAD

Tri-Star Computer Corp. aims to satisfy power users with an array of high-end PCs. The systems we tested—the \$5,295 Tri-Star Tri-CAD Vigor, a Pentium/90 tower; the \$3,255 Tri-Star Tri-CAD Pentium 66, Pentium/66 mid-tower system; and the \$2,155 Tri-Star Tri-CAD 486DX2/66, also a mid-tower PC—were all average performers that offer plenty of equipment for the price. Tri-Star sells mostly to corporate clients, specializing in high-end PCs for CAD/CAM and other graphics-heavy uses.

The 486DX2/66 offers ISA and VL-Bus slots. It came with a Sony double-speed CD-ROM drive, an ATI Graphics Wonder VL-Bus card with 2MB of DRAM, and a VL-Bus I/O card. A tall heat sink on the CPU crowded the ISA slots. The two Pentium units both have five ISA slots, three PCI slots, and integrated serial and parallel ports. They also came with ATI Graphics Pro Turbo video cards (with 2MB on the 66-MHz unit; 4MB on the 90-MHz system). The Vigor came with an IDE Sony CD-ROM and a SCSI Seagate hard disk with a PCI controller.

On all our tests, the Vigor posted average scores for its class. The Pentium 66 also turned in average scores, except on the Graphics WinMark 95 tests, where it turned in the top score in its group. The entry-level 486DX2/66 posted average scores on all tests.—Charles Lin

► **Tri-Star Computer Corp., Tempe, AZ;** 800-800-7668, 602-731-4926; fax, 602-731-4979.

Circle 491 on reader service card

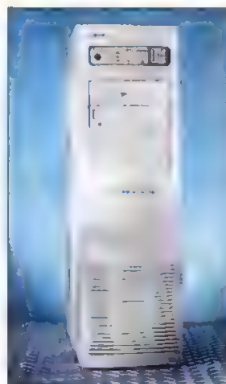
IN SHORT

Tri-Star Tri-CAD

Loaded high-end graphics machines with good performance.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



Unitek Technology Inc.

• Unitek

We received three machines from Unitek Technology for this review: the \$1,695 Unitek UT-486DX2/66LB mini-tower; the \$2,339 Unitek UT-P60, a 60-MHz Pentium-based desktop; and the \$3,279 Unitek UT-P90, a 90-MHz Pentium-based tower. The Unitek systems offered varying degrees of performance: Both Pentiums performed well in their respective tiers on our Windows-based tests, and the UT-486DX2/66LB's Windows scores were average. All three units are priced very aggressively for what they offer.

The major differentiator among the systems in this line, aside from processor and case type, is high-speed expansion bus: The two Pentium units both use a PCI bus, while the DX2/66-based system employs a VL-Bus. We have two minor gripes about the design of the Unitek systems. In the UT-P90, all SIMM banks are located underneath a drive cage, which makes upgrading somewhat of a hassle. And in the UT-486DX2/66LB, two of the five ISA slots will not take full-length cards due to the placement of the unit's CPU, while another ISA slot is not usable in this setup because its backplate is taken by the system's I/O ports.

On our tests, the Pentium systems turned in average to above-average scores under Windows, while the UT-486DX2/66LB's scores were mainly average within

IN SHORT

Unitek

Competitively priced all-purpose systems with solid performance.

their respective tiers. The UT-P90 posted an impressive Graphics WinMark 95 score, aided by an ATI graphics card with 4MB of VRAM. The units' DOS performance was average.—CAV

► **Unitek Technology Inc., Ontario, CA;** 800-949-5700, 909-930-5700; fax, 909-930-5710.

Circle 492 on reader service card



Vektron International Inc.

• Vektron Multimedia

The Vektron PCI Multimedia Ultimate/Pentium 90 (\$3,495), Vektron PCI Professional Multimedia/Pentium 60 (\$2,795), and Vektron Edutainment Multimedia/486DX266 (\$1,595) systems are clearly aimed at the home user. They come packed with a generous selection of CD-ROM software, a voice modem, a joystick, speakers, and a headset with built-in microphone. But their performance on our benchmark tests was poor. The Vektron Power Station line, reviewed separately, is not bundled with as many extras and is targeted at businesses.

IN SHORT

Vektron Multimedia

These poor performers do come loaded with extras for home users.



Stealth 64 card and a SCSI interface card in two of its four PCI slots. The Ultimate also came with a quadruple-speed CD-ROM drive, not the double-speed model used in the other machines.

Within their tiers, the Vektron Multimedia systems consistently trailed the pack on our tests. None of the machines mustered an above-average score. Except for the Disk WinMark 95 tests, the Ultimate scored below average on all our tests. And the Professional had nearly the worst Winstone 95 score in its class. The Edutainment had average scores on the DOS tests and on the Disk WinMark tests.—RSA

► **Vektron International Inc., Grand Prairie, TX; 800-725-0020, 214-606-0280; fax, 214-606-1278.**

Circle 493 on reader service card

Vektron International Inc.

• Vektron Power Station

For corporate and home-office PC users, Vektron International offers a full selection of tower PCs in its Power Station line. But despite attractive prices, the Vektron PCI Power Ultimate/Pentium 90 (\$2,995), the Vektron PCI Power Station/Pentium 60 (\$2,395), and the Vektron Windows Power Station/486DX266 (\$1,495) all placed near the bottom of their respective tiers on many of our tests.

Unlike the Vektron Multimedia series (reviewed separately), the Power Station units do not come with sound boards and are intended for corporate computing. All offered double-speed CD-ROM drives but, like the Multimedia series, were crowded inside since some controllers were not integrated. The Windows Power Station used a VL-Bus multifunction I/O card, while the Pentium units used an ISA slot for a floppy disk drive interface and a PCI slot for a hard disk controller. The Power Ultimate offers PCI and VL-Bus slots; the PCI Power Station (a Pentium/60 unit) has PCI slots; and the DX2/66-based Windows Power Station provides VL-Bus slots.

Relative to other high-end units, the Pentium/90 PC had below-average scores on most tests, except for an average Disk WinMark 95 score. The Pentium/60 PC got average scores for its tier on all tests except for below-average Graphics Win-

IN SHORT

Vektron Power Station

Well-priced and roomy business systems with poor performance.



Mark 95 and Winstone 95 scores. The 486DX2/66 unit posted average scores on all tests except the Graphics WinMark tests, where its score was below average.—RSA

► **Vektron International Inc., Grand Prairie, TX; 800-725-0020, 214-606-0280; fax, 214-606-1278.**

Circle 493 on reader service card

Xinetron Inc.

• Xinetron X/LAN

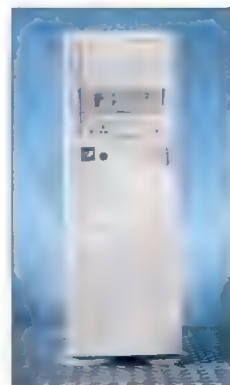
The X/LAN line from Xinetron, as its name implies, is targeted to business users with networks. The company also sells diskless workstations (not reviewed here). We received three X/LAN systems: the \$1,795 slimline Xinetron X/LAN 486/66; the \$3,895 mini-tower Xinetron X/LAN P66; and the \$5,399 tower Xinetron X/LAN P90. Only the 486/66 is competitively priced as configured. None of the X/LANs performed well on our Windows-based tests; their performance ranged from average to below average.

The 486/66 is an ISA/VL-Bus-based

IN SHORT

Xinetron X/LAN

Uncompetitive performers aimed at the networked corporate market.



PC. All slots are located on a riser card, which is curious given that the unit's motherboard has four ISA and two VL-Bus slots of its own. The riser card provides two ISA and two VL-Bus slots. All were occupied in our test configuration by CD-ROM, video, and combined I/O and disk controllers; and a Xi-

321 ethernet card. The Pentium units are both ISA/PCI/VL-Bus systems. They do not employ the same riser-card configuration as the 486/66; each has plenty of empty slots, though neither has integrated I/O. The P90 produced below-average scores in its class on all of our Windows-based tests except the Winstone 95 tests, for which it had a barely average score. The P66's test scores under Windows were average except for a below-average showing on the Disk WinMark 95 tests. In the entry-level group, the 486/66 garnered scores on our Windows-based tests that ranged from average to below average.—CAV

► **Xinetron Inc., Santa Clara, CA; 800-345-4415, 408-727-5509; fax, 408-727-6499.**

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Zenith Data Systems

EDITORS' CHOICE
ZDS Z-Station

If you're looking for a highly integrated, user-friendly, network-ready workstation that delivers on performance and has an exceptional warranty, look no further than Zenith Data Systems' PCI-based ZDS Z-Station line. We tested the \$3,692 486DX2/66-based ZDS Z-Station 500 and the \$5,327 Pentium/90-based ZDS Z-Station EX (prices include a \$999 17-inch monitor). ZDS offers its Z-Select line (not reviewed here) for users who don't need built-in networking capabilities.

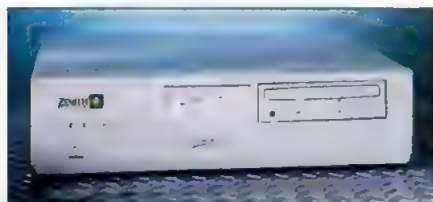
The covers of the slimline EX, an Editors' Choice winner, and the desktop 500 are easily removed by loosening a pair of thumbscrews. The 500 has built-in Ethernet connectors, while the EX uses SMC's ISA-based EtherCard Elite. Both have integrated video: an ATI Mach 64 with 2MB of VRAM for the EX and an ATI Mach 32 with 1MB of VRAM for the 500. The EX has a double-speed IDE CD-ROM drive; the 500 uses a double-speed SCSI unit.

On our tests, the Z-Stations were highly competent performers within their tiers. The EX produced average to above-average scores under Windows, earning second place on the Winstone 95 tests. The 500's scores were average, except for its just below-average Winstone score, due in part to its 32-bit graphics chip set.

The Z-Stations have a three-year warranty on parts and labor, with one year of on-site service included. —CAV

► **Zenith Data Systems, Buffalo Grove, IL; 800-582-0524, 708-808-5000; fax, 708-808-4434.**

Circle 495 on reader service card



236 PC MAGAZINE DECEMBER 6, 1994

COVER STORY

Pentium and 486 Buyers' Guide

ZEOS International Ltd.

• **ZEOS Pantera**

ZEOS International's Pantera PC line is a PCI-based, high-performance offering for power-minded buyers—and the units' performance on our tests certainly bears that out. ZEOS also sells the Ambra line of value-oriented, general-purpose VL-Bus-based PCs (not reviewed here and not related to the now-defunct IBM subsidiary called Ambra).

We tested three systems for our roundup: a \$2,095 ZEOS Pantera 486DX2-66 desktop, a \$2,995 ZEOS Pantera Pentium-66 desktop (a past Editors' Choice winner), and a \$3,195 ZEOS Pantera Pentium-90 tower. The Pentium-90 is ZEOS's biggest seller, and it's easy to see why: For the aggressive \$3,195 price, this PC includes a 15-inch monitor, a 1GB hard disk, and Lotus SmartSuite 3 for Windows.

The Pentium units' Winstone 95 performance was outstanding, each system leading its respective tier. They were above average on most other tests for their class.

The Panteras all feature integrated I/O, and each system's motherboard has a socket for an optional SCSI chip (\$49). The only design problem we continue to see is in motherboard layout—on all three Panteras, four of the systems' ISA slots cannot hold full-length cards. This aside, the Pantera line has a lot to offer—strong performance at a reasonable price, with excellent documentation.—CV □

► **ZEOS International Ltd., Minneapolis, MN; 800-554-7172, 612-362-1234; fax, 800-362-1205.**

Circle 496 on reader service card

IN SHORT

ZEOS Pantera

Overall performance leaders limited only by blocked ISA slots.

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



Five Good Reasons To Buy Peachtree Accounting For Windows.



December 18, 1993



March 1994



January 1994



March 1994



January 25, 1994

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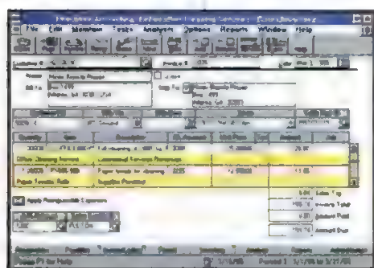
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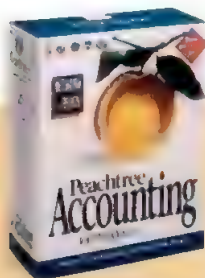
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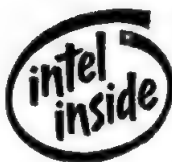
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MAINSTREAM GRAPHICS ACCELERATORS

Rush Power

What a relief. The 54 graphics accelerator boards PC Magazine Labs tested show a new maturity not only in benchmark test performance, but also in usability and, most of all, stability.

By Jeff Mace

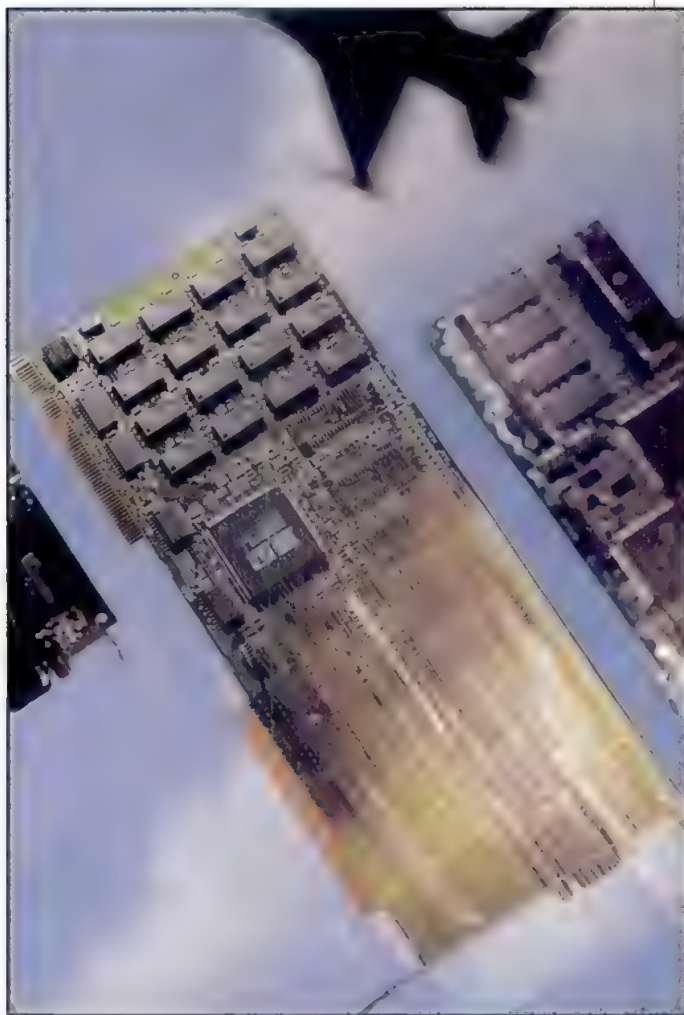
The graphics accelerator market has finally reached maturity. Four years ago, the release of Windows 3.0 precipitated a flurry of new graphics boards that guaranteed speedier graphics performance for the PC, but today's products have more than just Windows to contend with. The applications running under graphical environments demand more from your PC's graphics subsystem than ever before.

Few technologies have come so far in so little time. The top performer in this evaluation delivers six times the performance of the best accelerators we looked at just three years ago, and the offerings in the under-\$399 price range have never been better.

YOUR NEXT BOARD

Speed is no longer the deciding factor in choosing the best board. Although we evaluate graphics boards for speed, we also evaluate them for performance and stability, and we weigh in factors such as ease of use, installation, and overall usability when we make Editors' Choice selections.

Most of the products have added a variety of creature comforts to enhance productivity. These combinations of utilities, enhancements, and driver firmware, often de-



livered as add-on applets or control panels, provide easy means to switch resolutions and color depths without leaving Windows and make it easy to adjust refresh rates for output to a wide variety of monitors. Several products also add a host of other utilities including pan and zoom, display power management signaling (DPMS), and the ability to change resolution and/or color depth on-the-fly by using off-screen memory to let you select the size of the screen within the virtual-display space. Most boards also now include additional drivers for OS/2, Windows NT, and a variety of CAD applications.

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Obviously, the accelerator you buy must have the same bus type as your system, whether it's VLB (VESA Local-Bus) or the newer PCI (Peripheral Component Interconnect). ISA-bus system owners may look at ISA graphics cards as affordable alternatives, but the ISA bus's 16-bit bandwidth appears pretty limited when compared with the 32-bit channel of both VLB and PCI technologies.

A LONG ROAD

Over the past four years, as competition has become more fierce, board vendors have gone to great and sometimes questionable lengths to achieve the fastest benchmark score. To provide accurate testing and analysis, PC Labs has continually developed new benchmark tests every year to serve as a reality check for the vendors' latest claims.

Still, some opportunistic vendors have found ways to compromise the tests and artificially elevate their scores (see "Video Cards Revisited," *PC Magazine*,

July 1993). We continue to monitor this situation closely.

This highly competitive industry has also struggled with a pace of technological development so rapid that it results in a limited shelf life for many products. Companies rush to integrate the latest and fastest graphics processors, which often appear in six-month cycles. Chips that have been released on similar graphics accelerator boards only months before—and the people who buy them—are left high and dry. Fortunately, despite the fact that the development pace shows no signs of slowing, we are finally seeing the kind of quality-assurance controls that promote better driver stability.

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BETTER AND CHEAPER, TOO

While performance and usability have been on the upswing, prices have tumbled, in part because several chip vendors have integrated the digital-to-analog converter (also known as the RAMDAC), the processor, and clock functions (or clock synthesizer) into one part. Fewer parts mean lower manufacturing costs. This approach also requires less circuitry on the board and less fiberglass to solder it to, resulting in smaller, less complicated boards. Chips & Technologies, Cirrus Logic, and S3 have all adopted this approach in their F64300 Wingine DGX, CL-GD5434, and Trio 64 chips, respectively. The majority of the boards based on these chips are priced between \$179 and \$250; street prices are even lower.

Another method to keep costs down is to use inexpensive Dynamic Random Access Memory (DRAM). Most low-priced boards use DRAM as opposed to the more expensive, dual-ported Video Random Access Memory (VRAM). Some graphics board manufacturers now use a new type of DRAM chip, known as 16x256, which uses 0.5-micron technology. The higher density of this design allows more RAM to be integrated into a single chip. This simplifies the design of a graphics board by further reducing its overall chip count. Cards with the Cirrus Logic GD5434 and Tseng ET4000/W32p, as well as S3 chips, can be designed this way.

DRAM provides access to data by either the graphics controller or the RAMDAC, but not by both at once. As a result, DRAM-based designs often impose limitations on the refresh rate and processing times. Even the best-designed DRAM card can't sustain a VESA-compliant refresh rate, which is necessary for flicker-free display, at resolutions such as 1,024-by-768 with 24-bit color. The good news is that the DRAM cards in this evaluation benefit just as greatly from the increased bandwidth of the new accelerator chips as VRAM cards do. (For more information

on new video memory technologies, see the sidebar "Memories of Tomorrow.") If your requirements don't exceed a resolution of 800-by-600 with 65,000 colors, the more affordable DRAM-based cards will more than meet your needs, and you can expect them to perform comparably with VRAM-based boards at 800-by-600 resolution with 256 colors.

If you work with more graphics-intensive applications such as desktop publishing, image editing, or multimedia and need to work in 24-bit color all of the time, you'll reap the benefits provided by VRAM-based boards. The dual-ported VRAM outperforms DRAM at these resolutions by allowing simultaneous data transfers from the processor to the video memory and to the RAMDAC. VRAM enables the use of high speed 24-bit, 32-bit, and 64-bit SID (Serial Input Data) RAMDACs, which keep the screen refreshed with analog pixels at an extraordinary rate when running at high resolutions. Be advised, though, that to reach a resolution of 1,024 by 768 or better with 24-bit color, you will need more than the 2MB of VRAM featured on the boards in this roundup.

THE PLAYERS

In this evaluation we look at 53 mainstream graphics accelerator boards that have a list price of less than \$399, have at least 2MB of video memory, and can provide resolutions of up to 800 by 600 with 65,000 colors or more. All the products we tested were shipping by August 19, 1994. We accepted all PCI- and VLB-based boards that met these criteria. There are no ISA boards in this evaluation, but many of the products we review do come in ISA versions. Though it was outside the price cutoff we established, we also included our recent Editors' Choice, the \$449 Matrox MGA Impression (*PC Magazine*, June 28, 1994), for the sake of comparison.

Nearly 30 companies submitted boards, and the differences among the boards—in chip implementation, RAMDACs, and video memory—affect price and performance. That makes choosing the right board for your system harder than ever, but our reviews and the results of our benchmark testing should



- **ATI Graphics XPression 2MB VLB**
- **ATI Graphics XPression 2MB PCI**

With the ATI Graphics XPression 2MB VLB and PCI boards, ATI Technologies has proven that it understands the mainstream graphics mar-

ket better than almost any of its competitors. Combining stellar graphics performance, affordability,

and an excellent set of add-on utilities to help you configure your screen image just the way you want it, the XPression PCI and XPression VLB earn our Editors' Choice awards.

The XPression immediately impressed us with rock-solid drivers that adroitly handled every one of our tests. ATI seems to have thought of everything. In addition to its well-designed screen-configuration utility that lets you preview a host of color, refresh, and resolution combinations, ATI has even included an uninstall feature in case you should ever decide you want to remove the utilities—but we doubt you'll use it.

Although speed is no longer the primary and defining factor in our graphics accelerator evaluations, we certainly weren't disappointed by ATI's results. The XPression boards yielded top-level performance numbers in the standard resolution and color depth for mainstream users: 800-by-600 with 256 colors. Also worth mentioning here are the ATI Winturbo VLB and PCI, which, while more expensive than most boards, outperformed all others on our Winstone 95 tests at 800-by-600 in 24-bit color mode.

ATI wasn't the only vendor paying attention to mainstream users' needs.

help you make the right decision. We used our new WinBench 95, Winstone 95, and PC Bench 9.0 tests, which reflect our continuing efforts to keep up with the latest changes in the industry. What may be most telling is our Price/Performance Index, which uses price, performance, and other factors, including board construction and driver stability, to rate overall value. This chart gives

We were also impressed by a number of other offerings. The Diamond Stealth 64 VLB and PCI boards led the pack in raw speed on several of our benchmark tests. Though we found much to praise in them, the unpredictable operation of a few essential features, such as the previewing of screen-configuration combinations, gave us the overall impression that these utilities are still incomplete.

Number Nine Computer Corp. virtually invented several features now common among graphics boards, and the company provides an add-on feature set that in some respects rivals those of our Editors' Choice winners. We were impressed with the Number Nine #9GXE64 VLB and PCI boards, as well as the #9GXE64Pro PCI, but the boards fell behind our Editors' Choices in price and performance.

There were a few bargains among the graphics boards we evaluated. The STB PowerGraph 64 PCI and PowerGraph Pro PCI are reasonably priced and are better-than-average performers. The PowerGraph Pro was the first graphics accelerator we saw with the new S3 Trio64 chip. Also worth noting is the affordable and innovative RasterOps ColorImpact 100 VLB, which lets you upgrade video memory with standard SIMMs.

you the best sense of which boards offer you the best bang for the buck.

THE SIXTY-FOUR-BIT QUESTION

More than half the boards we reviewed have 64-bit chips. Matrox first introduced its 64-bit MGA chip in mid-1993, and Weitek brought out its 64-bit chip in the first part of 1994. Since then, chip manufacturers have been following suit. S3

HIGHLIGHTS

Mainstream Graphics Accelerators

DRAM OR VRAM memory is one of the first decisions you have to make when you shop for a graphics accelerator. If you work mostly in word processing or other nongraphical applications, you can get affordable performance at high resolutions (1,024-by-768) and average color depths (256 to 65,000) with DRAM. True color aficionados who spend their time rendering 3-D art and altering photographic images should invest in more expensive VRAM memory to access high-performance, 24-bit color.

THE CHIP AND THE BUS, the heart and soul of any graphics accelerator, can make all the difference in how well a board performs and therefore in what you decide to buy. Among our 54 boards, PCI and VL-Bus types are almost equally represented. On the other hand, the number of accelerator types has virtually exploded, so

choosing the right board is now more difficult than ever. Our brand new benchmark tests help delineate the performance differences across bus type and chip brand.

SOFTWARE AMENITIES now make up a major part of every purchasing decision. Many boards support Windows-based control panels with access to utilities that support on-the-fly resolution switching and color calibration. A stable set of drivers is also a must.

NEW TECHNOLOGIES in the graphics acceleration market are coming to the fore. A handful of the boards we tested support the new DCI (Display Control Interface), but it is a technology that is clearly in its infancy. Other advancements to watch out for include display power management support (DPMS) and reduced chip sets.

now offers both the DRAM-based Vision864, VRAM-based Vision964, and DRAM-based Trio 64; ATI has the mach64 DRAM and mach64 VRAM. The Cirrus Logic CL-GD5434 uses DRAM.

These 64-bit chips provide a two-way 32-bit data path twice as wide as that of older 16-bit chips. Where they really strut their stuff is in processing large raster operations (ROPs) imposed by 24-bit color image editing, desktop publishing, and digital video. BitBlts (bit block transfers) and other ROPs usually tax system resources, including the disk, memory, and graphics subsystems, since only so much data can be processed per clock cycle. Also, 24-bit color datastreams, which have to be handled in three separate 8-bit channels, and the 8-bit alpha channel (which can be present in 24-bit images) add up to a total of 32 bits of pixel data to be moved around.

Another approach is the 32-bit interleaved chip, which is now used on all 2MB Tseng Labs ET4000/W32p-based

boards. Although the chip's internal data path is half that of the 64-bit accelerators, its interleaved data scheme provides nearly the same data throughput. On our tests, the data transfer rates in 800-by-600 resolution with 8-bit color resolution kept up with the 64-bit chips. Since this chip uses DRAM, it's a real bargain for the end user. But the point of departure may be in the areas of digital video, 24-bit color, and high screen refresh rates, where increased data rates directly benefit from the wider data path provided by the 64-bit chip. These chips would also benefit from being able to work with VRAM.

The proliferation of multimedia software and snazzy CD-ROM titles adds a new burden—digital video—to a graphics card's already full plate. Some of the products in this roundup have open chip slots to accommodate digital video accelerator chips to come later. These chips work in concert with the graphics accelerator chip to decompress and scale the video stream. Several products have been

released, and integrated solutions for digital video processing and scaling within the graphics chip from S3 have just been announced, but most were either not ready or were above our \$399 price cutoff at the time of this roundup.

UP NEXT

A whole host of improvements is in the works for the ever-expanding graphics board market. For example, we'll soon see hardware support for digital video, new memory designs, and 3-D graphics.

Because processing-intensive digital video files must, like any other Windows paint-to-screen operation, travel through the Graphics Device Interface (GDI), playback quality leaves something to be desired. The alarming amount of data that makes up even the smallest digital video file has been bound by this restriction—until now. Microsoft has announced its support for Intel's DCI (Digital Control Interface) specification, which provides for direct hardware writes to the video processing device (see the sidebar, "DCI: Driving Multimedia Forward").

Board manufacturers will be integrating 3-D accelerators in the near future. You can currently find support for 3-D functions in the Matrox MGA II chip, which supports such features as Gouraud shading (which renders a skin onto any 3-D wireframe vector graphic). Boards featuring 3-D processors such as 3D Labs' GLiNT chip will soon be available on graphics cards costing around \$1,000 or less, depending on memory configurations.

While high-end graphics users and digital video enthusiasts can use all the help they can get in moving pixels around, high-end speeds may be *too fast* for mainstream users. The combination of Microsoft Excel and one of these graphics cards, for example, can give you whiplash. One click too far to the right and you're suddenly zipped from column A to column AZ. The fact is, some of these boards are now so fast that, in some instances, they have to wait for the CPU to catch up.

Even though this technology continues to advance at an alarming rate, now is *not* the time to hurry up and wait. The products we cover here are great solutions for today's computing needs.

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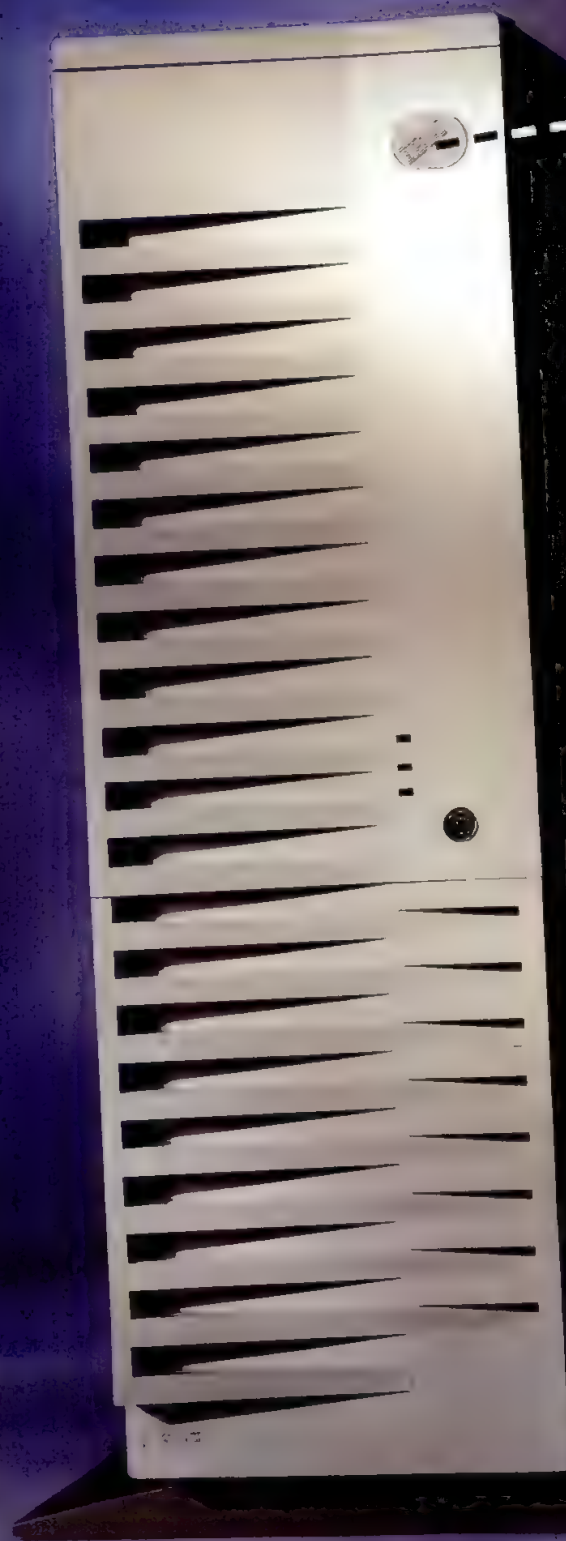
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Mainstream Graphics Accelerators

Acronics Systems Inc.

• Acronics ASI2000 Orion VLB 64

• Acronics ASI2020 Taurus PCI 64

BY JONATHAN HILL

The Cirrus Logic CL-GD5434 chip that powers the Acronics ASI2000 Orion VLB 64 (\$269) and ASI2020 Taurus PCI 64 (\$269) is a relatively new design that integrates a graphics accelerator, 24-bit RAMDAC, and clock crystal in a single chip. Unfortunately, the CL-GD5434 didn't perform as well as its S3 Vision864-based competition on our benchmark tests, and the two Acronics entries suffered as a result. The differences are barely noticeable in 8-bit color modes. But if 24-bit color is important to you, in this price range you'd be better off sticking with one of the 864-based boards that managed to maintain a decent refresh rate (72 Hz or better in 24-bit color at 800-by-600 resolution), or move up to one of the VRAM solutions.

Both the DOS and the Windows installations load CLMode, a refresh rate and monitor selection utility. CLMode is necessary for proper utilization of the Windows drivers.

CLMode allows you to select the monitor type from a predefined list or create your own custom configuration. You can verify that the chosen refresh rate/resolution combination works with your setup, and use the Video Modes Preview to check all of your selections and fine-tune them using a centering facility.

More sophisticated graphics cards save their new configuration directly into an on-board EEPROM or set an environment variable to point to a configuration file location. The two Acronics boards save the configuration as a set of command line switches for CLMode, which runs from your AUTOEXEC.BAT. You can also load a standalone version of the centering utility, CENTER.COM, as a terminate-and-stay-resident (TSR) file.

WINDOWS SETUP

Acronics' Windows utility, WinMode, is nearly identical to utilities offered by Actix Systems, Boca Research, and a host of other midsize graphics vendors.

The program contains a single screen that lets you change the resolution, color depth, and refresh rates associated with the Windows drivers. Acronics has modified this standard screen by adding a section that lets you to alter the size of the Font Cache and an Operating System option that lets the Windows drivers work in 16 or 256 colors under OS/2. Like many other DRAM-based products, both the Taurus PCI 64 and the Orion VLB 64 drop down to a refresh rate of 60 Hz in 24-bit color modes,



Today's GUI applications stretch the limits of your graphics subsystem. Fortunately, the graphics accelerator boards we review here can easily satisfy GUI demands.

which can become tiresome if you do much true color work.

The Orion VLB 64 was a below-average performer on the Winstone and WinBench tests, finishing in the bottom 25 percent in 16- and 24-bit color modes. DOS performance on our PC Bench tests was less than stellar but is probably adequate for most users' needs. The Taurus 64 did just as poorly on the 16- and 24-bit WinBench tests, and was also slightly below the average in 8-bit color mode at 800-by-600 resolution.

All in all, the performance profiles for the Orion VLB 64 and the Taurus PCI 64 are closer to those of lower-priced boards such as RasterOps Corp.'s Truevision ColorImpact 100 VLB than to products in or above its price range. Acronics also

markets lower-priced, 32-bit versions of its cards. These \$169 boards contain 1MB of RAM each and are based on Cirrus Logic's new CL-GD5430 accelerator chip.

► **Acronics Systems Inc.**, 46560 Fremont Blvd., Bldg. 203, Fremont, CA 94538; 510-770-3400; fax, 510-490-8367.

Circle 497 on reader service card

Actix Systems Inc.

• Actix GraphicsEngine 64 VLB

• Actix GraphicsEngine 64 PCI

• Actix GraphicsEngine Ultra 64 PCI

BY JONATHAN HILL

Actix Systems continues its tradition of delivering good performance at a reasonable price with the Actix GraphicsEngine 64 VLB and PCI (\$229 each) and Actix GraphicsEngine Ultra 64 PCI (\$345). The boards don't have many fancy frills, but they managed to maintain high refresh rates while scoring acceptably on our benchmark tests. The VRAM-based Ultra 64, which ranked third on the 24-bit WinBench 95 tests, is worth considering if you do a lot of true color work.

TEST RESULTS

The GraphicsEngine 64 is a DRAM card based on the S3 Vision864 accelerator. Both the VLB and PCI versions performed well on PC Bench's DOS video tests. WinBench results place the boards near the center of the range on the 8-bit tests at 800-by-600-pixel resolution and the 16-bit tests at 1,024-by-768 pixels, but like nearly all of the other DRAM-based cards, the boards' performance dropped off in 24-bit color modes. Both units did, however, manage to hold a refresh rate of 72 Hz with 24-bit color at 800-by-600 resolution.

The GraphicsEngine Ultra 64 PCI is based on the S3 Vision964, a VRAM-specific accelerator. Its performance profile was similar to that of its DRAM siblings when using 8-bit color, but it performed well above the average on the 16- and 24-bit WinBench tests. What's more, Texas Instrument's TI 3025 RAMDAC allowed the GraphicsEngine Ultra 64 to refresh the display at a rate of 100 Hz in 24-bit color mode at 800-by-600. The combination provides a fast, saturated display.

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- Hard disk: 270MB (540MB optional)
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- Bus: PCI/ISA
- RAM: 8MB to 128MB
- Secondary cache: 256KB to 512KB
- Hard disk: 270MB (540MB optional)
- Slots: 1 ISA, 1 PCI/ISA, 1 PCI
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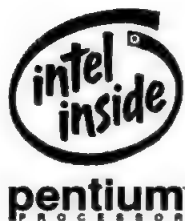
Celebris™ 590

- Chassis: Full Profile
- Processor: Pentium
- Diskette drive: 3.5" 1.44MB
- Bus: PCI/ISA
- RAM: 8MB to 128MB
- Secondary cache: 256KB to 512KB
- Hard disk: 540MB
- Slots: 3 ISA, 1 PCI/ISA, 1 PCI
- Storage bays: 4 ext., 2 int.
- Graphics: S3 864 with Hawkeye drivers
- Monitor: 14" SVGA color
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*Three-year limited hardware warranty. Certain restrictions and exclusions apply. **July 1994 issue.

Mainstream Graphics Accelerators

SETTING UP

Actix provides DOS- and Windows-based installations, but both of these could stand a little improvement. If you choose to load the Windows drivers from the DOS installation program, the program copies the appropriate files and leaves you in Windows' own Setup program, without activating the drivers. The Windows-based program doesn't let you install the DOS utilities, so you must run both installations.

Mode Select lets you change resolution and color depth in addition to the refresh rate. The program automatically updates your AUTOEXEC.BAT with the new settings. Only the refresh rate can be changed without restarting Windows.

The GraphicsEngine Ultra 64 also comes with a program called UltraCen. This is a centering utility that allows you to fine-tune the display size and position for each resolution.

In short, once you get around the confusion between the two conflicting refresh rate utilities, the GraphicsEngine 64 VLB and PCI and the GraphicsEngine Ultra 64 provide midrange performance at a reasonable price. That market segment is fairly crowded, but if you can find the boards at a good discount, these three boards from Actix are all worth a look.

► **Actix Systems Inc.**, 3350 Scott Blvd, Bldg. 9, Santa Clara, CA 95054; 800-927-5557, 408-986-1625; fax, 408-986-1646.

Circle 498 on reader service card

American Megatrends Inc.

- **American Megatrends Fast View VLB**
 - **American Megatrends Fast View PCI**
-

BY JAN OZER

American Megatrends Inc. (AMI) is best known as a BIOS and motherboard manufacturer that provides high-performance, cost-effective products to the upper echelon of computer makers. Unfortunately, AMI hasn't forged the same formula for the American Megatrends Fast View VLB and PCI graphics accelerators. Built around Weitek's 32-bit Power 9000 graphics chip, the VRAM-based products consistently ranked at the bottom of our benchmark tests, while at \$399, they are among the most expensive boards we tested.

On the positive side, both boards provide stable, wide-screen viewing, producing 1,280-by-1,024 resolution with 256 col-

ors at 75 Hz on supported monitors, and they proved rock-solid in our compatibility and usability testing. As you would expect from a manufacturer of AMI's stature, both boards were solid and well constructed. But while the newer PCI configuration shows promise, both boards lack software extras, such as virtual display and on-the-fly mode switching, provided by other less-expensive products.

The two AMI boards are the only boards we tested that are still using Weitek's outdated Power 9000 graphics accelerator. In 32-bit color mode, the Weitek chip offers half the bandwidth of 64-bit engines featured by most other boards in this roundup. This theoretical limitation translated directly to substandard performance on our benchmark tests.

Compared with other VLB boards, the Fast View VLB was among the slowest in the DOS-based PC Bench testing; the 800-by-600, 24-bit Winstone testing; and the three WinBench tests. The PCI board also fared poorly, placing near the bottom in PC Bench and Winstone testing and on all WinBench tests.

The WinBench scores are particularly troublesome. These tests run the boards through a synthetic suite of Windows GDI routines. The Fast View boards' scores were very low compared with those of other products in their class.

BARE-MINIMUM SOFTWARE

Unlike many boards we reviewed, both boards' drivers installed quickly using the standard File/Run sequence under Windows' Program Manager. The VLB board uses an installation program supplied by Weitek, while the newer PCI version uses a new custom installation developed by AMI.

Both boards offer presets for only five monitors. The product manuals describe how to build custom monitor configuration files, but this is obviously less desirable than a comprehensive set of monitor presets.

The VLB board's configuration program provides bare-minimum features, and program operation can be cumbersome. For example, you must select resolution and color depth from different windows. Unavailable color depth options aren't grayed out after you select the resolution; because of this, we got multiple "Color depth not available" error messages. Most other developers simply gray

out the unavailable choices and avoid the problem. Also, AMI didn't build in display centering capabilities for various resolutions and refresh rates.

The Fast View PCI has a new interface, featuring an uninstall program and the ability to center displays not supported by presets. Otherwise, the program was devoid of creature comforts.

The Weitek chip set did yield software stability. The time-tested and memory-efficient drivers withstood all applications torture testing with ease, a distinction not shared by many other products. The only glitch was an apparent conflict with the Video 1 codec, a Video for Windows staple.

Neither AMI board offers much for OEMs or retail customers to get excited about. Perhaps AMI will soon put this older technology to bed and pursue more current technologies and newer and faster video engines.

► **American Megatrends Inc.**, 6145-F Northbelt Pkwy., Norcross, GA 30071; 800-828-9264, 404-263-8181; fax, 404-263-9381.

Circle 499 on reader service card

Appian Technology Inc.

- **Appian Renegade 1280 VLB**
-

BY JAN OZER

The \$390 Appian Renegade 1280 VLB answers the question, "What happens if you win an Editors' Choice and don't update your product for a whole year?" In this fast-moving market, you fall behind. While the Renegade's pure performance numbers remain strong, several competitors leapfrogged the board in performance and software extras, preventing a repeat by last year's Editors' Choice winner.

PROMISES UNKEPT

Last year, the Renegade topped the field with blazing speed and bare-bones software. Built around Appian's AGC98032 32-bit graphics accelerator and 2MB of VRAM, the board continues to perform well, even against 64-bit processors. The Renegade topped the VLB charts in the 800-by-600, 8-bit WinBench tests and came in just behind the top two 64-bit driven Diamond Stealth cards at 1,024-by-768 with 8-bit color.

Unfortunately, it's mostly downhill from there. After our technicians noticed extreme heat emanating from the Renegade, we began looping the benchmark

Mainstream Graphics Accelerators

tests continuously. During these torture tests, the Renegade crashed repeatedly, usually about every 90 minutes. In addition, despite the fact that the company assured us last year it would expand true color support, the Renegade is one of the few boards that couldn't produce 24-bit color at 800-by-600 resolution.

The Renegade's installation and configuration software is also showing its age. With the exception of a virtual desktop feature, Renegade is devoid of the software extras delivered by other boards in this evaluation.

You install the Renegade's monitor driver and utilities through a simple DOS or Windows installation; the setup worked well until it was time to select a monitor. Although the program included many monitor presets, the NEC Multi-Sync 4FG test-bed wasn't one of them, and it took about 20 minutes of trial and error to configure our monitor.

When you install the Windows drivers, you get an Appian icon in the Windows control panel. The Windows configuration program provides bare-bones control over resolution and color depth and an on/off switch for the Renegade's virtual display.

Although most virtual display implementations enable control over virtual window size, Appian's does not. Also, the virtual window feature is not documented, and there is no on-line help; the virtual display information is detailed only in a READ.ME file included on the installation disk. Once installed, however, the virtual display operates smoothly and is a nice addition to the program. Overall, the Renegade performed well in compatibility testing, showing efficient memory management and stable drivers.

Last year, a speedy graphics engine and speedy benchmark test scores were sufficient to win Editors' Choice honors. In the last twelve months, though, 64-bit engines from ATI, Matrox, S3, and other chip developers have practically turned high-performance graphics scores into a commodity. As high-end developers such as Matrox and Number Nine migrate into the retail consumer market, buying criteria shift from speed alone to the features found in driver and utility software.

And in that regard, Appian is way behind the curve.

► **Appian Technology Inc.**, 4010 Moorpark Ave., #105, San Jose, CA 95117; 800-727-7426, 408-985-1543; fax, 408-985-1545.

Circle 500 on reader service card

ATI Technologies Inc.

EDITORS' CHOICE ► **ATI Graphics XPression 2MB VLB**

EDITORS' CHOICE ► **ATI Graphics XPression 2MB PCI**

• **ATI Winturbo VLB**

• **ATI Winturbo PCI**

BY JAMES KARNEY

The ATI Graphics XPression 2MB and Winturbo graphics adapters, both based on the company's ATI mach64 graphics accelerator, should please discerning shoppers looking for a reasonably priced yet powerful and feature-rich graphics board. The \$249 Graphics XPression is a DRAM-based board, and the \$369 Win-

olution without exiting Windows; FlexDesk+, for controlling the card's configuration under Windows; and DeskScan, for managing the virtual desktop (the feature offers pan and zoom functions). All these features are contained under one easy-to-use interface known as the ATI Desktop. A separate pop-up routine in WinSwitch lets you switch resolution and pixel depth via hotkeys or with a mouse click. We encountered no difficulty in moving between different settings, even with several applications active at the same time.

A color-calibration utility lets you match the card and your monitor to the type of color you would use for your output. Also, in the FlexDesk+ control panel, you can access an outstanding monitoring routine for adjusting refresh rates and testing combinations of resolution and color depth. The interface is very well

designed; even a novice can adjust a monitor using slider bars, and you can preview new settings by clicking a button. The original settings are restored after a user-defined interval—a handy feature if your settings are testing the scope of your monitor's capabilities. If, for some reason, you want to remove the drivers and restore the pre-ATI settings, there's an uninstall routine.

Both cards come with accelerated video-playback drivers, which replace the standard Video for Windows drivers. ATI has built video acceleration directly into the mach64 chip design. The current drivers do not support the new Intel Indeo 3.2 method of digital video compression, but ATI has indicated that upgrades are on the way. One nice touch is the ability to tune the color, brightness, tint, and contrast of the video image display window independently of the rest of the desktop. We were able to

clean up a dingy clip using the Motion Video utility's slider bars.

The mach64 works with the VESA display power management signaling (DPMS) energy-saving controls if your system supports them. ATI also includes AutoCAD, 3D Studio, MicroStation, and Unix drivers, as well as OS/2 drivers that support all resolutions and color depths.



turbo is VRAM-based. Both are available in 2MB PCI and VLB (and ISA) versions. The boards' common graphics engine and driver software resulted in similar installation and overall performance. All four scored very well on our tests and come with top-of-the-line Windows drivers, utilities, and installation routines.

Software enhancements include WinSwitch, for changing color depth and res-

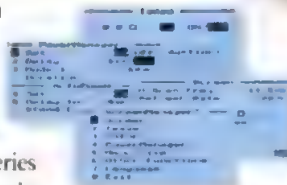
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Price/Performance Index: Graphics Accelerators



Our Price/Performance Index offers a clear sense of how much you may be giving up to get a cheaper board, and

how much you'll gain by buying a more expensive one. The boards in the upper-right-hand corner of the chart offer the best bang for the buck.

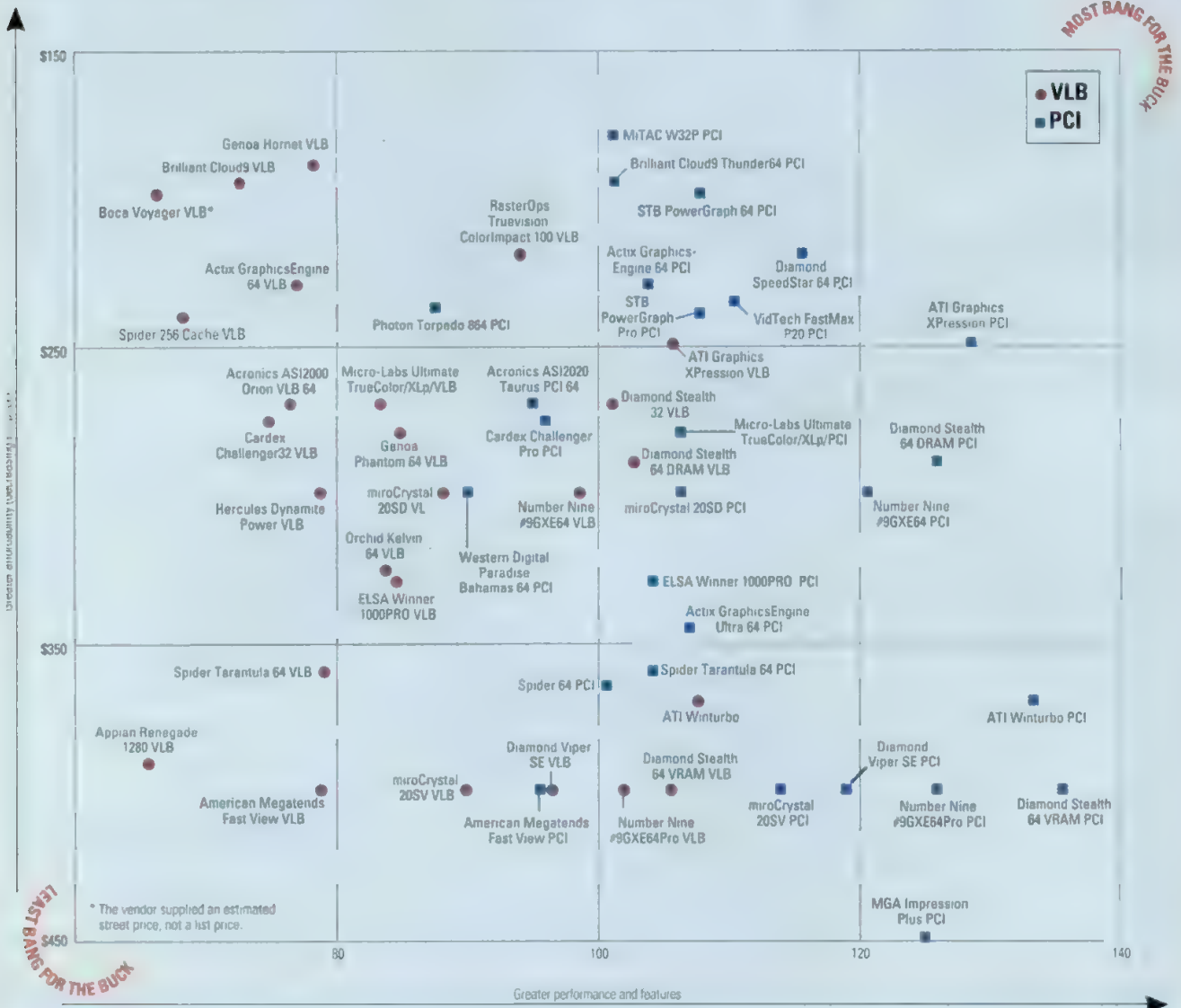
We've included VL-Bus and PCI cards together in this chart, but you shouldn't try to compare their scores

directly. To help you differentiate between the two types of graphics accelerators, the PCI and VLB boards are represented by different shapes (see the key in the upper-right corner). Because of the different platform, the PCI-based boards generally fare better than their VL-Bus counterparts.

To arrive at the "bang" part of our equation, we gathered actual benchmark test scores and averaged them. A product's composite benchmark test

score comprises nearly half of its "bang." Then we input a collection of other weighted factors, including warranty, construction quality, ease of installation, digital video playback support, and BBS and 24-hour tech support.

We also included a rating for creature comforts. We considered utilities for resolution switching, virtual display, and other tasks. We also considered how easy it was to implement and use the utilities.



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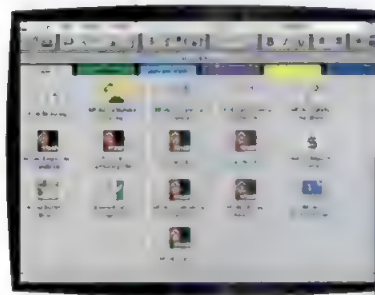
Naturally, in such a highly competitive field, the sophisticated security available with Notes is a critical feature.

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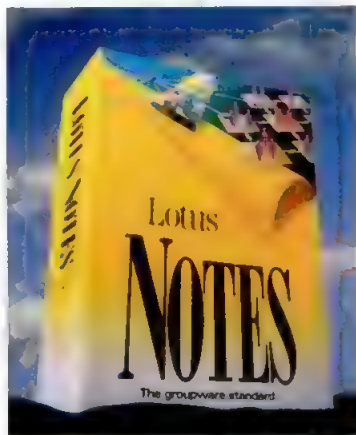


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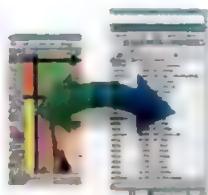


Invasion of the 64-bit Graphics

The squadron of 64-bit graphics accelerators from ATI – the GRAPHICS PRO TURBO, WINTURBO and GRAPHICS XPRESSION – has landed. Affordably priced from only \$179, they're attacking computers with rocket-like performance, laser sharp graphics and galactic true colors.

Hi-res, True Color Universe

Resistance is futile. High resolutions of up to 1280x1024



WinSwitch

Change resolution and color without exiting Windows

and 16.7 million true colors will overwhelm you. These advanced accelerators propel applications faster in true color than other cards using just 256 colors. And superior performance – up to 42 million Winmarks* – will conquer even the most complex applications. Plus, flicker-free display – up to 100Hz – reduces eye-strain over prolonged periods of attack.



EDITOR'S CORNER

"When it comes to pure performance, the GRAPHICS XPRESSION towers above its competition. ... even outran leading VRAM boards such as the Diamond Viper Pro and the Matrox MGA Ultima ..."
PC World, 09/94

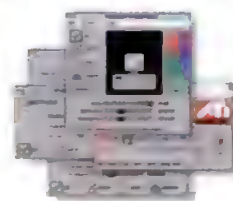
"The GRAPHICS PRO TURBO is the fastest board we've ever seen."
PC World, 09/94

"(GRAPHICS PRO TURBO) ATI not only has the edge in true-color acceleration, but, on average, it takes first place in AutoCAD tests ..."
Computer Shopper, 09/94

(GRAPHICS PRO TURBO) ... 8.6: top score in test of eight PCI graphics cards
Infoworld, 07/25/94

Propelling Windows

Armed with an arsenal of utilities to enhance Windows, the mach64 graphics accelerators breeze through Windows applications quickly and effortlessly. The unique WinSwitch feature allows color and resolution to be changed – without restarting Windows. And features like FlexDesk+ and DeskScan allow you to easily customize your Windows environment, or pan and scroll across a large virtual desktop space.



FlexDesk+

For enhanced operation and complete control of Windows options

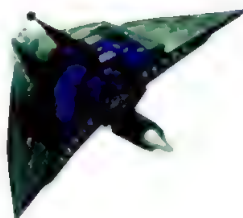
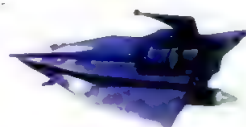
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* Results using WinBench 4.0 and PC Bench 8.0. All performance tests done on a Pentium 90MHz, 16MB RAM, 256K cache, 420MB HD, using 2MB and 4MB PCI graphics cards using WinBench 4.0 at 1024x768 resolution with 256 colors (large fonts) or 800x600 in 16.7M colors (small fonts) at 70Hz refresh rate. Performance may vary for other operating systems and system configurations.

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Conquering Other Systems

A stellar range of software drivers enable popular operating systems and applications to be explored – OS/2 (32-bit, Win-OS sessions), UNIX, Windows, Windows NT, CAD, DOS and others. ATI's commitment to stable, high quality drivers guarantee timely updates for new versions of popular operating systems. 32-bit drivers for Windows 95 (Chicago) with full resolution and color support are being tested now.

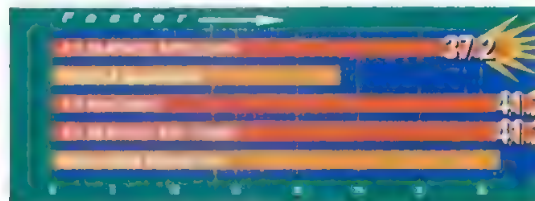
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WINBENCH 4.0 - 16.7 million colors



WINBENCH 4.0 - 256 colors



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- Supports OS/2, Windows, and Windows NT at any resolution, any color depth
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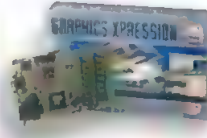
Outperforms other accelerators in Windows.

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- Color calibration software
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July 25th 1994



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Mainstream Graphics Accelerators

COST-CONSCIOUS

The DRAM-based Graphics XPression is aimed squarely at the budget-minded. The 2MB configuration lists for \$249 and can provide up to 1,280-by-1,024 resolution with 256 colors and a 70-Hz refresh rate. It can handle 24-bit color with a 75-Hz refresh rate at both 640-by-480 and 800-by-600 resolutions. In addition, the Graphics XPression 2MB offers 16-bit color depth at both 1,024-by-768 and 1,152-by-864 with a 75-Hz refresh rate.

The VRAM-based Winturbo, on the other hand, comes with a \$369 price tag and ATI's 68860 SpectraDAC instead of the SGS-Thomson STG 1702J-13Z RAM-DAC found on the Graphics XPression. It offers the same software amenities and display resolutions and drivers as its DRAM sibling. Thanks to its VRAM design and improved high-color-depth performance, this card is better suited to users who plan on spending time in true color mode.

The use of DRAM doesn't necessarily result in lower test scores across the board. The PCI Graphics XPression outperformed other boards on our 8-bit Winstone tests at 800-by-600 resolution and was almost as strong in 24-bit mode at the same resolution. The VLB board also performed extremely well on the same tests.

The Winturbo fell slightly behind the Graphics XPression on the 800-by-600, 8-bit tests, but the VRAM did help it in true color modes. If you limit your activities to less graphics-intensive applications such as word processing packages, and if you only rarely venture into true color modes and programs such as Adobe Photoshop, the DRAM may not be a liability at all—and it can save you money.

FINE-TUNING

Installing the Graphics XPression or the Winturbo is a two-step process. The primary installation routine, which is run under DOS, queries the system to identify any possible conflicts with other cards that might already be using their default settings. Once that's taken care of, you select the proper configuration to match your monitor. You can use the ATI Quick Setup to configure the card for the majority of drivers or the Advanced Setup to create a custom definition. The advanced options are complete; they include the ability to select the power-up video mode

(VGA color or VGA monochrome), determine the bus I/O (16-bit or 8-bit) mode, enable linear memory, and set wait states on ISA versions of the card. You can use the last two options to resolve conflicts with other devices.

Finally, the setup program installs Windows drivers in DOS. Then, from within Windows, you can easily tune the drivers to obtain the maximum refresh rate using the FlexDesk+ slider bar controls. Additionally, you can set the virtual desktop and WinSwitch modes. In all, it's clear ATI has put a lot of work into its drivers and software features: In our testing, the setup routine was very clean and the drivers very stable.

Overall, the ATI cards were the top-ranking products in each category in our benchmark testing. Couple that with their low prices and loads of extras, and the Graphics XPression and Winturbo are real bargains that provide considerable value.

► **ATI Technologies Inc.**, 33 Commerce Valley Dr. East, Thornhill, ON, Canada L3T 7N6; 905-882-2600; fax, 905-882-2620.
501 on reader service card

Boca Research Inc.
• **Boca Voyager VLB**

BY JONATHAN HILL

The Boca Voyager VLB (\$199, estimated street price) is a no-nonsense card aimed squarely at cost-conscious users who spend most of their time running DOS programs and mainstream Windows applications such as word processors and spreadsheets. The Voyager isn't bundled with fancy utilities, doesn't provide drivers for 24-bit color modes at resolutions greater than 640-by-480, and only supports resolutions higher than 1,024-by-768 at interlaced refresh rates that produce flickering displays that bring back memories of IBM's ill-fated 8514/a standard.

On the other hand, on our 8-bit, 800-by-600 Winstone tests, the Voyager ranked fourth among the 25 VLB cards we tested. The key to the board's performance is its Chips & Technologies F64300 Wingine DGX graphics accelerator. The C&T chip makes use of a proprietary video-caching technique, using a small amount of memory dubbed XRAM to speed up screen refreshes while its main DRAM chips get ready for the next clock cycle. The effect is to speed up overall system performance.

WATCH YOUR STEP

Boca's Windows-based setup program lets you install the Voyager Windows drivers, several DOS drivers, and the Voyager utilities. Windows utilities include the Voyager Control panel, which allows you to set the resolution, color depth, and refresh rate; and Ramspeed, which lets you program the board's memory-access speed to fine-tune performance.

DOS tools include a centering utility and a standard VGA-mode test facility. There are no DOS utilities for changing the board's memory-access speed, which is set at 80 MHz.

Playing around with the memory speed is not something for the average user; prolonged use of higher memory access speeds can adversely affect performance. The included README file warns that, "When increasing the memory speed, make sure that your system has an adequate cooling system. Running the Voyager at high speeds and higher temperatures may cause problems in display...", so use it at your own risk. When we looked into this, a company representative stated that most users should have no problem working within the range provided by the Windows utility.

Given the lack of support for high color depths and resolutions, there is little incentive to purchase the 2MB version that we tested; but for an estimated street price of \$145, the 1MB version of the Boca Voyager buys you top-notch DOS performance, stable Windows response with 256 colors, and the ability to view 24-bit files at 640-by-480 resolution.

► **Boca Research Inc.**, 6413 Congress Ave., Boca Raton, FL 33487; 407-997-6227; fax, 407-997-0918.

Circle 502 on reader service card

Brilliant Computer Products
• **Brilliant Cloud9 VLB**
• **Brilliant Cloud9 Thunder64 PCI**

BY JOHN R. QUAIN

As two of the least expensive graphics adapters in this roundup, the \$195 Brilliant Cloud9 VLB and Cloud9 Thunder64 PCI boards from Brilliant Computer Products (BCP) offer reasonable performance for business users. What these cards lack are the quick true color speed and convenience features of more expensive offerings.



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Mainstream Graphics Accelerators

STORMY WEATHER

The Cloud9 VLB is a DRAM-based board founded on NCR's 77C32BLT 32-bit accelerator chip. In testing, it turned in excellent DOS and solid 8-bit color Windows performance. However, the Cloud9 VLB suffered from weak 24-bit color performance and from software annoyances.

The model we tested included a DOS-based installation utility, which wasn't as straightforward as it could have been. Furthermore, refresh rate switching has to be performed via a DOS utility, while color depth and resolutions are adjusted through a Windows utility. Consequently, it's possible to choose conflicting software drivers that prevent the board from booting Windows.

On the other hand, for business users, the Cloud9 VLB board represents something of a bargain. It can handle an ergonomic 75-Hz vertical refresh rate in 800-by-600 mode with 256 colors, although at its top resolution of 1,280-by-1,024 with 256 colors, the refresh rate drops to a less-than-optimal 60 Hz.

In DOS tests, the Cloud9 VLB turned in the best PC Bench score among all the VLB boards. The board's Winstone 95 results were close to the top in this group, as long as we didn't increase the color depth to 24 bits. Users bent on 24-bit support will find that the Cloud9 VLB lacks some of the snappy reactions that faster boards offer and will be disappointed with the 60-Hz vertical refresh rate in 24-bit, 800-by-600 mode.

Users with more pedestrian needs, however, may want to consider the 1MB version of this board. It lists for only \$145 and delivers nearly the same performance in 8-bit color modes. What you give up with the additional memory is 800-by-600 true color.

RUMBLES ABOVE

Owners of mainstream PCI systems will find that BCP's other graphics board, the DRAM-based Thunder64, is a more well-rounded performer. Based on S3's 64-bit Vision864 accelerator, the Thunder64 also suffers from fewer software inconsistencies than the Cloud9 VLB.

The Thunder64's DOS-based installation ran without a hitch on PC Labs tests.

Although some users may chafe at the DOS-only refresh-rate utility, BCP expects to include a Windows-based one by the time you read this. Furthermore, where some of the bottom-tier cards could not do better than a 60-Hz vertical refresh rate in 800-by-600, 24-bit color mode, the Thunder64 was able to maintain a VESA-compliant 72-Hz vertical refresh rate.



On PC Labs' Winstone test, the Thunder64—while not the slowest PCI performer—was about 20 percent slower than the more expensive VRAM leaders. At the same time, the Thunder64 managed to keep up with most of the other boards on WinBench 95 tests when only 8-bit color was needed, but when the color depth was increased, its performance fell substantially below that of the top VRAM-based PCI adapters.

Both of BCP's boards offer reasonable performance within their price range. What you'll find missing here are ergonomics and convenience features such as a utility to handle DPMS power-saving modes. True color enthusiasts should look elsewhere, while cost-conscious business users may consider these a good deal.

► **Brilliant Computer Products**, 562 South Milpitas Blvd., Milpitas, CA 95035; 408-942-3315; fax, 408-942-7788.

Circle 503 on reader service card

Cardexpert Technology Inc.

• **Cardex Challenger32 VLB**

• **Cardex Challenger Pro PCI**

BY JAN OZER

In choosing the Tseng ET4000/W32P graphics accelerator chip for its Cardex Challenger32 VLB and Challenger Pro PCI and graphics boards, Cardexpert Technology proves that if you live by the OEM chip, you occasionally die by it, too. Like all products built around the Tseng engine, the Challenger cards consistently placed behind boards using S3's Vision864 and 964 chips and behind proprietary chips developed by ATI, Matrox, and others.

As a result, the Challenger cards provided middle-of-the-road performance on our Windows benchmark tests. With a suggested retail price of \$275, each of these boards is priced within fifteen or twenty dollars of faster products that also provide more extensive software features and add-on utilities.

Both boards come with 2MB of DRAM, enabling 24-bit color at 800-by-600 and 16-bit color at 1,024-by-768. The boards are soundly constructed, although both monitor connectors are somewhat recessed, making them a bit difficult to connect.

JUST AVERAGE

Cardexpert provided us with the latest Tseng Labs Windows installation program, which ran smoothly for both boards. Tseng Lab's Windows configuration program provided little in the way of extra usability features other than a pseudo-preview mode consisting of a small monitor icon with text inside. When we selected 1,024-by-768 resolution, the text inside the monitor got smaller. Selecting 640-by-480 resolution made the text larger. This isn't quite as illuminating as the preview modes provided by other products that actually display the current application at the new resolution and refresh rate.

On Windows benchmark tests, both the VLB and PCI versions of the Challenger board were average. Each dropped refresh rates to 60 Hz during our 800-by-600, 24-bit WinBench tests, a portent of future eye strain for those working in higher resolutions with either

Mainstream Graphics Accelerators

one of the Challenger boards.

Performance was equally mediocre compared with that of the other four graphics boards using the Tseng ET4000/W32p engine. DOS benchmark scores were the one brief highlight for the Challengers, with both producing numbers near the top of the pack.

In Windows compatibility testing, neither board proved to be a memory hog. Our driver-stability and usability tests involved loading four Windows applications and then switching to DOS programs running in DOS windows. On our 16MB test machines, most boards retained approximately 25 percent of system resources after loading the four Windows apps, while the Challenger32 VLB reserved only 9 percent and the Challenger Pro PCI a mere 4 percent. As a result, neither product was able to complete the tests successfully.

On the whole, Cardexpert designed a decent but not stellar chip set into its Challenger series and did next to nothing to improve performance or usability. The end result is two average boards, without even the benefit of an affordable price. **► Cardexpert Technology Inc., 2908 Scott Blvd., Santa Clara, CA 95054; 408-748-1118; fax, 408-748-0346.**

Circle 504 on reader service card

Diamond Multimedia Systems Inc.

- Diamond SpeedStar 64 PCI
- Diamond Stealth 32 VLB
- Diamond Stealth 32 PCI
- Diamond Stealth 64 DRAM VLB
- Diamond Stealth 64 DRAM PCI
- Diamond Stealth 64 VRAM VLB
- Diamond Stealth 64 VRAM PCI
- Diamond Viper SE VLB
- Diamond Viper SE PCI

BY BEN MYERS

Although they use graphics engines from four different chip makers, the nine Diamond graphics boards in this evaluation have a consistent physical construction and set of utilities that manage resolution, color-depth switching, and refresh rates. But Diamond's utilities are a shade below top-notch. They don't give Windows users a foolproof way to preview a new combination of resolution and refresh rate, to center a new image on-screen at the new resolution, or to adjust the aspect ratio. These capabilities are essential for

preventing you from burning out your monitor.

The InControl Tools found with many of the Diamond cards supply preset resolution and color-depth combinations keyed to the brand name and model of your monitor. If your monitor is not on the list, you simply choose a custom monitor type, then select the resolution and refresh-rate combinations appropriate for your display. InControl's test button is activated any time you're dealing with a user-defined monitor setting (as opposed to the brand-specified ones).

Diamond's Windows utilities take a somewhat singular approach to zooming, giving you the ability to view a part of the screen at greater than normal magnification. While the utilities with many of the boards in our roundup magnify at two or four times the basic resolution, zooming with a Diamond board enlarges an area by displaying it at the next lowest resolution supported at the current color depth. The driver also manages the power-suspend, power-standby, and power-off timing intervals for the cards when used with a monitor that complies with the VESA display power management signaling (DPMS) standard.

The driver software for all of the Diamond boards also supports a virtual desktop, which establishes an overall resolution greater than the actual resolution at which the monitor is operating. Diamond is also one of the few vendors in this evaluation that already supports the new Display Control Interface (DCI) video spec in the driver software.

POINT OF LIGHT

The \$219 Diamond SpeedStar 64 PCI owes its diminutive size (it's the same length as a PCI slot) to a Cirrus Logic CL-GD5434 chip and four 16-bit, 256K, 60-ns DRAM chips. The CL-GD5434 integrates graphics engine, RAMDAC, and clock in one neat package. The SpeedStar 64 also comes bundled with the CorelDRAW 3.0 CD-ROM.

The maximum monitor refresh rate is limited by the DRAM memory on the card. This limitation is most significant when operating the SpeedStar 64 at either 800-by-600 resolution with 16.7 million

colors or at 1,280-by-1,024 with 256 colors. In these cases, the refresh rate is only 60 Hz, well below the VESA standard, causing serious flicker, especially in a room with fluorescent lighting. Otherwise, the maximum refresh rate is 90 Hz at 640-by-480 or 800-by-600, and 75 Hz for 1,024-by-768 or 1,280-by-1024.

At 800-by-600 with 256 colors, the SpeedStar 64 performed nearly 20 percent more slowly than other VRAM-based cards in this roundup. At 800-by-600 with 16.7 million colors, its WinBench and Winstone scores were clumped near the bottom with other boards that used the CL-GD5434 chip. The SpeedStar 64 won't be a cost-effective choice if you intend to operate it at 16.7 million colors or with video applications, but otherwise it's quite respectable.

STILL STEALTHY

The \$199 Diamond Stealth 32 PCI, based on the Tseng Labs ET4000/W32p chip, is yet another small 2MB graphics card: It's switchless and jumperless and has satin-smooth surface-mount construction. It uses 60-ns, 16-bit DRAM memory, known as 16x256, which needs only four memory chips to make up 2MB. Despite its DRAM architecture, the Stealth 32 PCI managed to sustain refresh rates that met minimum VESA requirements. In our benchmark testing, the board was the fastest card on DOS benchmark tests and ranked in the middle or higher on all Windows benchmark tests.

Diamond supplies the same InControl utility software and identical drivers with all of the Stealth 32 and 64 cards.

The Diamond Stealth 32 VLB also costs \$199, and its hardware and software feature set is virtually identical to that of its PCI sibling. In benchmark testing, the Stealth 32 VLB nosed out the other ET4000/W32p-based boards for top DOS honors and scored in the middle on Windows tests.

GREAT PERFORMANCES

The \$399 Diamond Stealth 64 VRAM PCI is engineered around the 64-bit S3 Vision964 chip, a Brooktree 485 RAMDAC, and 2MB of 60-ns VRAM (upgradable to 4MB). The board worked flawlessly with the PC Labs Windows mainstream usability tests. On our

Benchmark Tests: Mainstream Graphics Accelerators

Driver optimization continues to be a major factor in the performance scores of graphics accelerators. In many cases, different products using the same components performed differently on the same benchmark tests. Our results illustrate that vendors still need to work on optimizations for higher color depths at both the chip and driver levels.

What the Numbers Mean

Since the graphics processor cannot accelerate all the Windows GDI calls, it is up to the driver to turn many complex calls into graphics primitives that can be accelerated by the graphics controller. For example, a driver will have improved performance if it has algorithms tuned to break down complex GDI calls comprising ellipses and circles into series of polylines and polyline fills that the graphics controller understands.

We cannot compare the benchmark test results of cards based on two different bus types—PCI and VL-Bus—because we had to run them on different systems to reflect accurately the results you might find under real-world circumstances. For that reason, we separated the PCI and VLB results.

For comparison, we tested three previous *PC Magazine* Editors' Choice winners reviewed from 1991 to 1993 (right). These boards were all ISA-based, and we tested them on our 90-MHz Pentium test-bed.

FAST ENOUGH

Regardless of the memory implementation—DRAM or VRAM—or the graphics accelerator chip the manufacturer used, most of the products lined up shoulder to shoulder on our WinBench 95 and Winstone 95 tests at 800-by-600 resolution with 256 colors (8-bit color). This proves two things. First, there's no bottleneck at this resolution, because even after refreshing the screen at 72 Hz, there is more than enough bandwidth left over in a DRAM board to handle acceleration. Secondly, if you use this resolution, an inexpensive DRAM-based product with the right features will comfortably meet

your needs.

On the 800-by-600, 8-bit-color WinBench (Graphics WinMark) tests, the middle performers were a mix of 32-bit and 64-bit processors. ATI's 64-bit Graphics XPression 2MB PCI performed only slightly better than the 32-bit Diamond Stealth 32 PCI and Cardex Challenger Pro PCI (which is based on the W32p). Similarly, VLB boards such as the 64-bit Diamond Stealth 64 maintained no more than a 10 percent lead over the Boca Voyager VLB, which uses the 32-bit Chips & Technologies F64300. We consider a 10 percent difference in results too small to be perceived by a typical end user.

On the 800-by-600, 8-bit Winstone 95 tests, scores were also closely grouped regardless of processor and memory types. There was less than a 10 percent spread across all VLB Winstone 95 scores, compared with a 22 percent spread on the PCI platform.

HISTORICAL SCORES: GRAPHICS WINMARK (800-by-600 resolution, 8-bit color)



These areas of similarity disappeared when we tested the boards at higher color depths—16-bit and 24-bit color. Here, in fact, VRAM overtook DRAM. VRAM-based 64-bit accelerator boards led on the Graphics WinMark and Winstone tests at these higher color depths. The ATI mach64, Matrox MGA, and S3 Vision964 chips all performed in nearly a dead heat on these tests.

The VRAM-based ATI Winturbo PCI was about 20 percent faster than

the DRAM-based ATI Graphics XPression PCI on the WinMark tests at 800-by-600 in 24-bit color mode. Similar spreads were exhibited in this mode by the Diamond Stealth 64 VRAM PCI, which was 33 percent ahead of the Diamond Stealth 64 DRAM PCI. Also, the VRAM-based Spider Tarantula 64 PCI was one of the fastest boards, while the DRAM-based Spider 64 PCI was among the slowest in this same mode. Boards based on the Tseng Labs ET4000/ W32p had scores nearly 45 percent below the fastest boards in this mode, and products based on the Cirrus Logic CL-GD5434 were more than 55 percent below the fastest boards.

DEEP COLOR

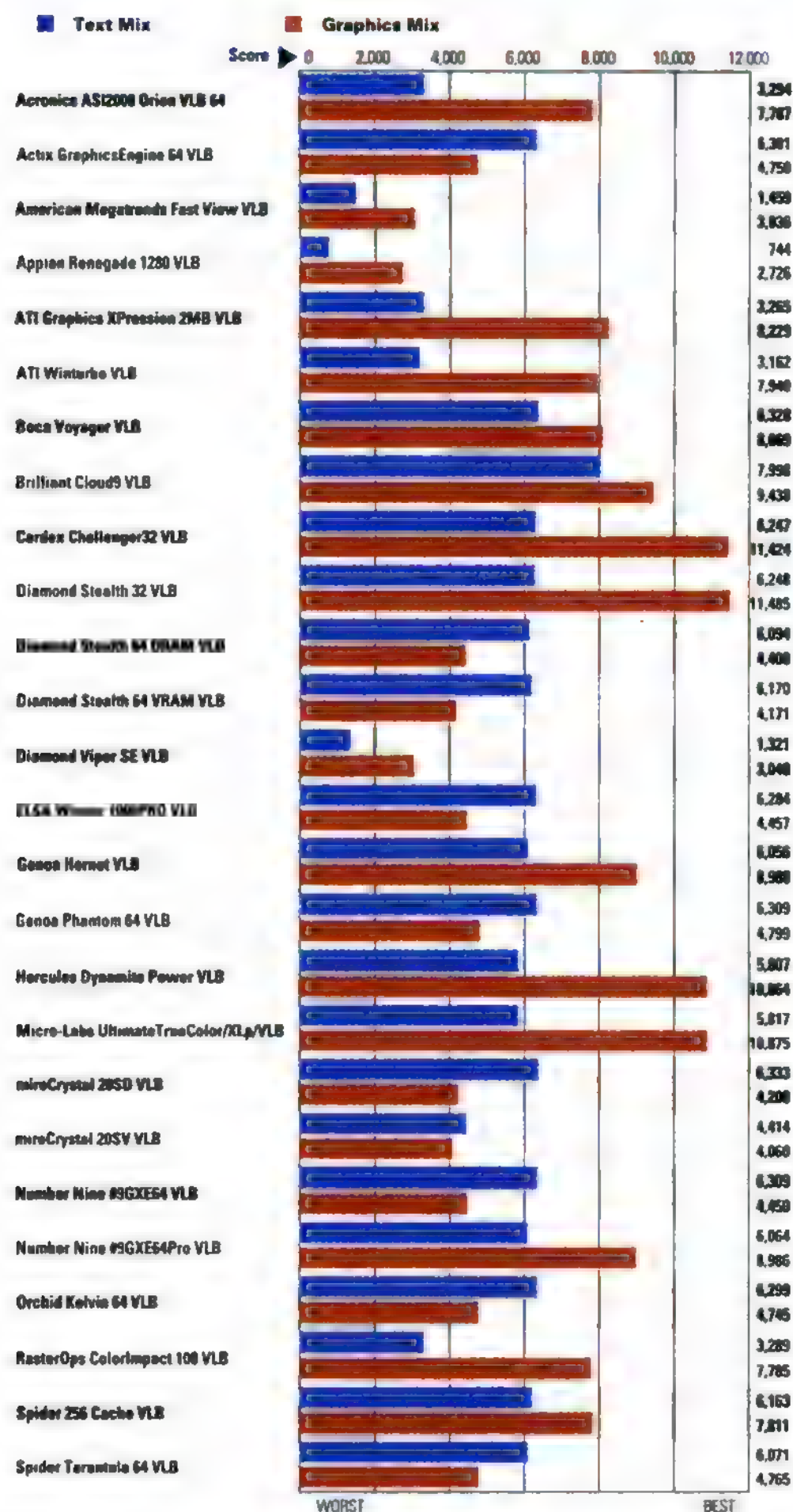
We also tested the boards in 1,024-by-768 with 16-bit color on the Graphics WinMark tests. This resolution may become the mainstream resolution of the future, as larger monitors replace 14-inch units. With graphics board vendors providing a large-font option, the 1,024-by-768 display becomes truly usable on a 15-inch monitor—but even better on a 17-inch. At this resolution, the VRAM boards outperformed DRAM products on both our PCI and VLB test-beds.

The greater differences between these memory types still appeared, though, at 24-bit color, where the bandwidth required is twice that of 16-bit color. Besides memory type, the speed of the graphics controller was a limiting factor in a board's performance. Chips directly supporting optimization for 16-bit color have a clear edge.

One of the slowest boards at 1,024-by-768 with 24-bit color was the American Megatrends Fast View, which is based on the Weitek Power 9000, a chip that only accelerates 8-bit color operations. The best overall performers at the chip level were boards based on the S3 Vision864 and 964. The S3 Trio64, represented on the STB PowerGraph 64 PCI, scored within 19 percent of the top-performing board. Lesser performers were based on the C&T 64300 Wingine

PC BENCH 9.0

VLB Boards (486DX2/66)

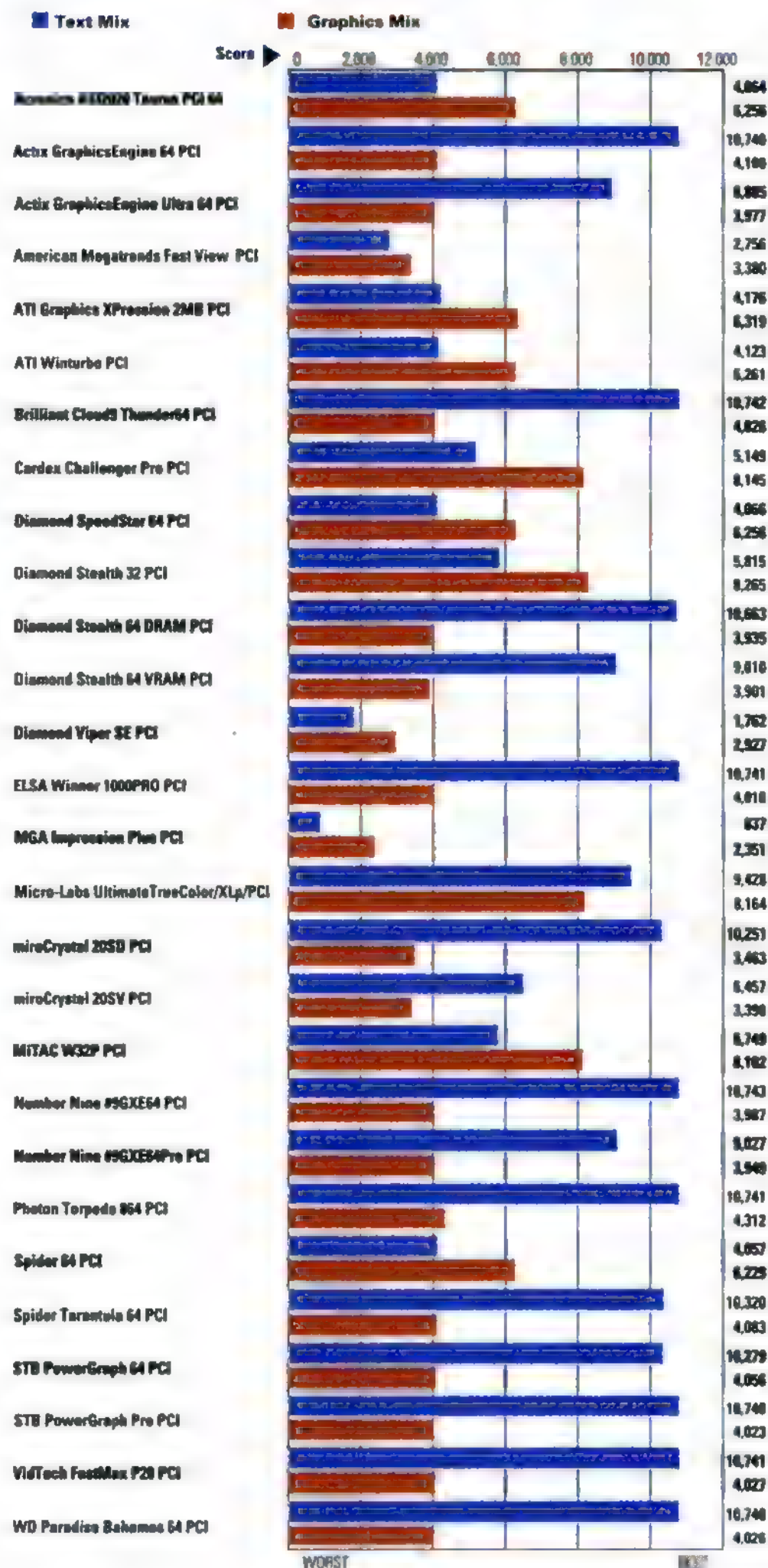


DGX, the NCR 77C32BLT, and the Cirrus Logic CL-GD5434.

Two Diamond products took the lead on the Graphics WinMark tests at 1,024-by-768 with 16-bit color. The W32p-based Diamond Stealth 32 PCI's excellent performance can, in part, be attributed to Diamond enabling the 16-bit-color port on the chip and using linear-memory addressing as opposed to memory-bank addressing at the driver level. Other boards based on the W32p had scores 30 percent lower on the same test.

On our PC Bench tests, which examine DOS text and graphics performance, the results showed that Tseng Labs

PCI Boards (Pentium/90)

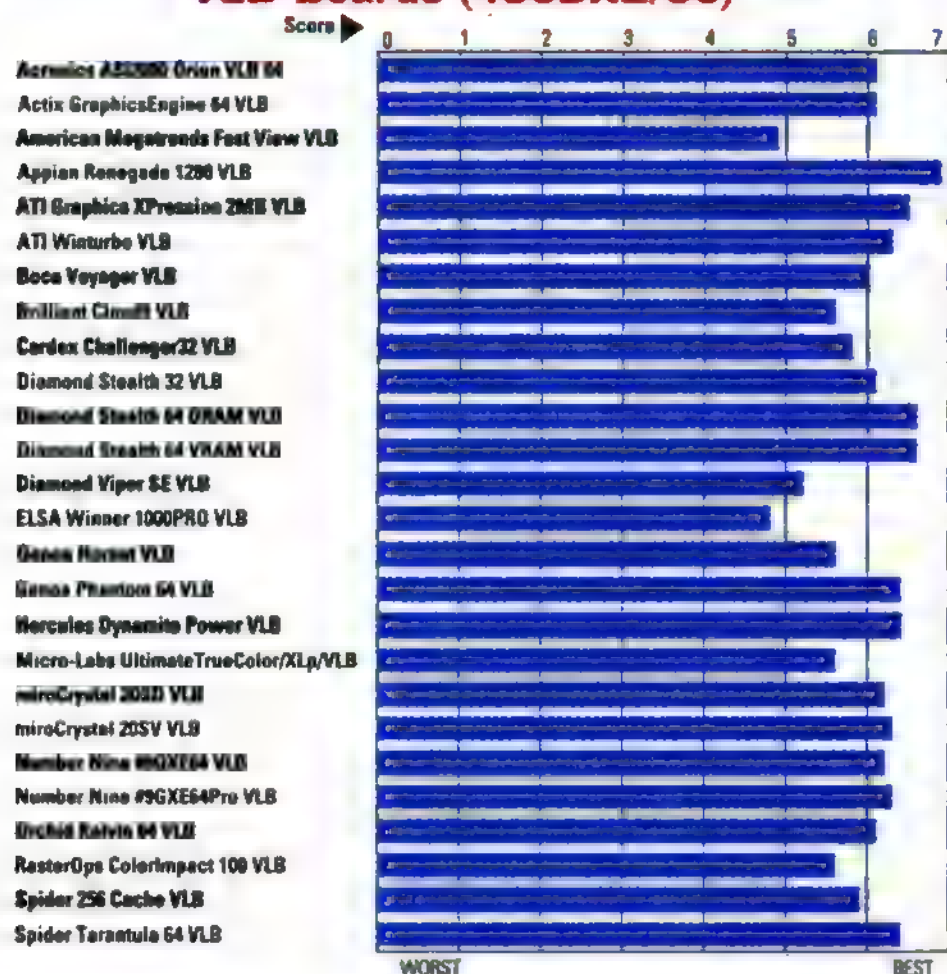


maintains dominance in overall DOS video performance with its ET4000/W32p chip. Out of the five top-performing graphics boards in this area, four incorporated this Tseng chip. NCR's 77C32BLT also ranked near the top with strong text performance, although it was not quite as efficient as the Tseng in terms of graphics speed. Adapters based on the C&T 64300 Wingine DGX, and many of those using the S3 Vision864 and 964 chips, scored quite well. Graphics accelerator boards using Matrox and Weitek

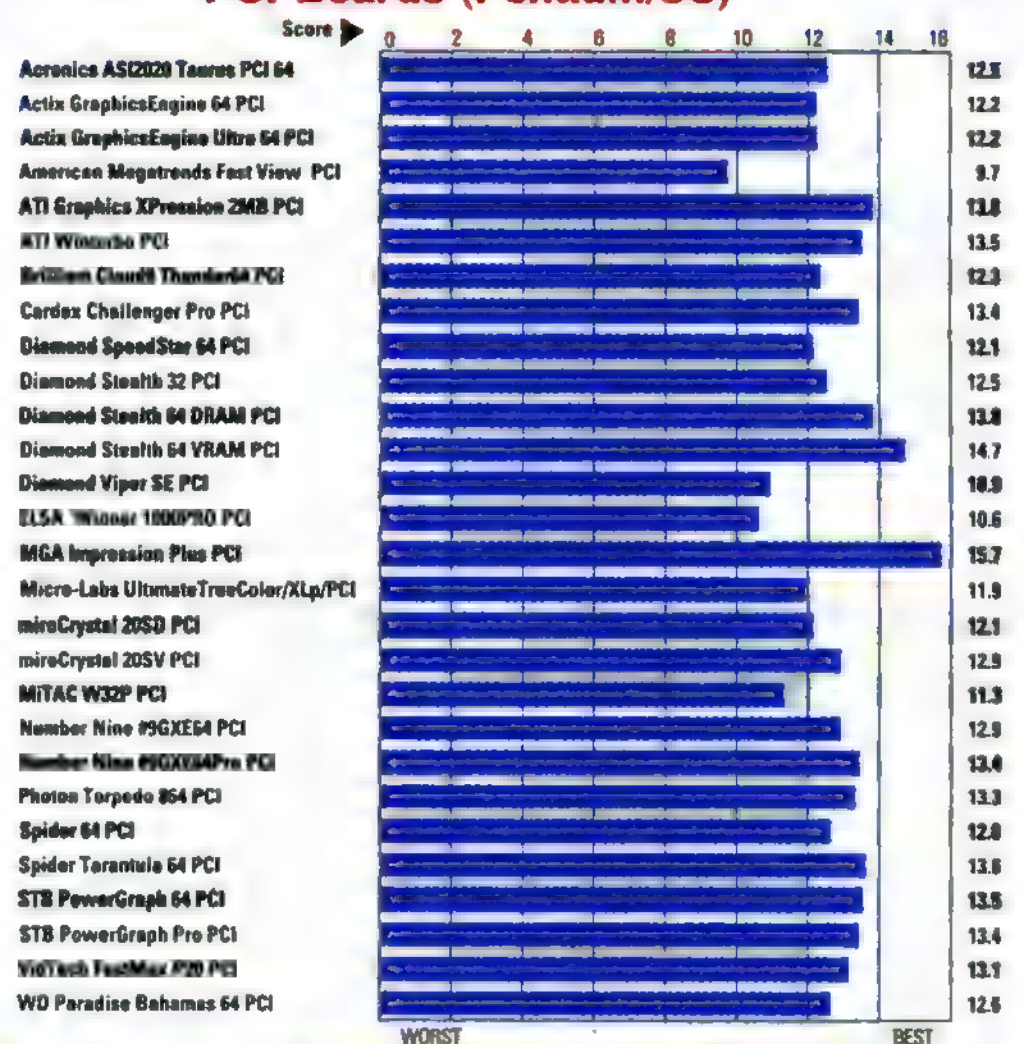
Benchmark Tests: Mainstream Graphics Accelerators

GRAPHICS WINMARK 95 (800-by-600 resolution, 16-bit color)

VLB Boards (486DX2/66)



PCI Boards (Pentium/90)



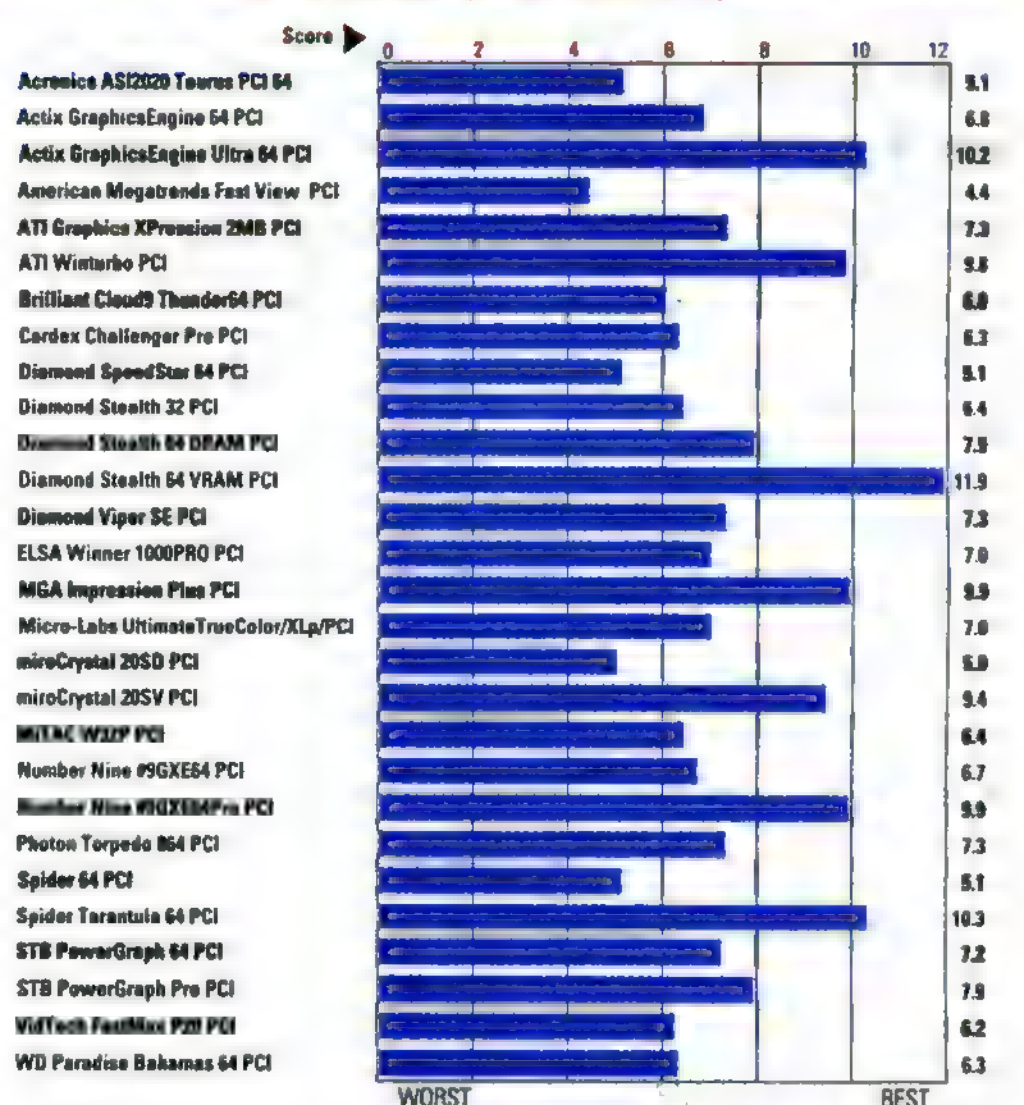
GRAPHICS WINMARK 95 (800-by-600 resolution, 24-bit color)

VLB Boards (486DX2/66)



N/A—Not applicable. The board does not support this resolution and color depth.

PCI Boards (Pentium/90)



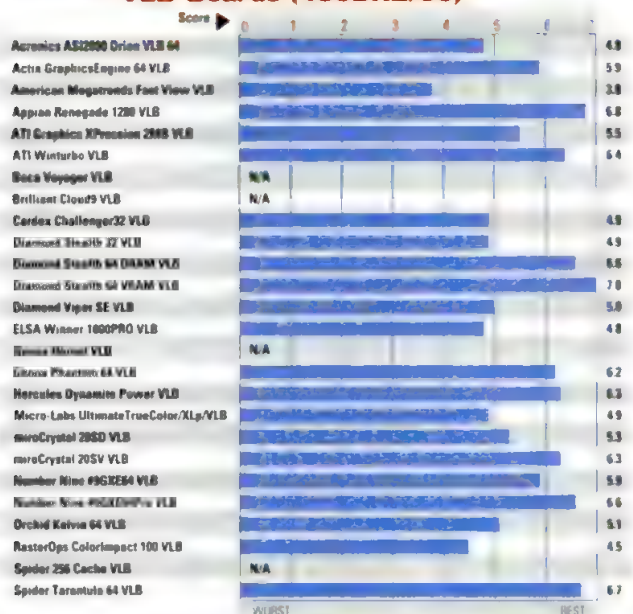
components continued to bring up the rear.

It is impossible to make *direct* comparisons across our VLB and PCI test-beds, but we did notice some interesting trends. Because many vendors sent us both VLB and PCI versions of the same graphics board using the same chip set, we conducted a limited analysis of VLB versus PCI performance. Generally, the PC Bench text scores showed the

PCI-based adapters performing better than the VLB adapters from the same vendors—which reflects the influence of the test-bed processor speed, not of bus architectures. But the graphics tests broadly depicted the VLB-based adapters outperforming their PCI counterparts by up to 30 percent in some cases, indicating PCI-bus bottlenecks

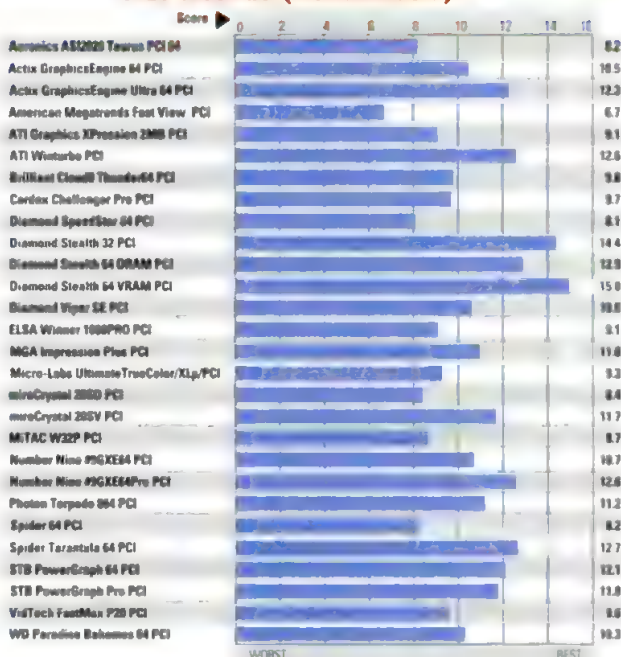
GRAPHICS WINMARK 95 (1,024-by-768 resolution, 16-bit color)

VLB Boards (486DX2/66)



N/A—Not applicable. The board does not support this resolution and color depth.

PCI Boards (Pentium/90)



WINSTONE 95 (800-by-600 resolution, 8-bit color)

VLB Boards (486DX2/66)



PCI Boards (Pentium/90)

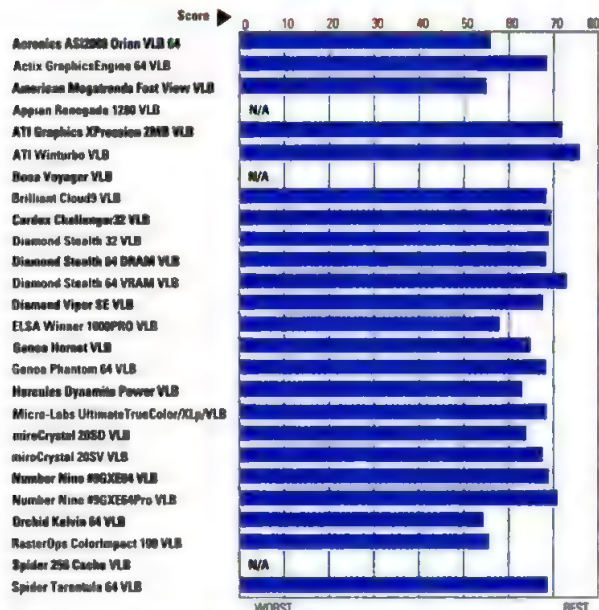


as the likely culprit. The fact that the VL-Bus runs at 33 MHz in the DX2/66, compared with the PCI bus running at 30 MHz in the Pentium 90, is not sufficient to explain the varied results. Our analysis suggests that the VLB-based cards were outperforming PCI cards from the same vendors on most 16-bit and 32-bit memory-to-screen, screen-to-memory, and screen-to-screen graphics operations. The

direct coupling of the VL-Bus to the processor (compared with the additional logic and buffering seen in PCI chip sets) may benefit VLB designs when large, unidirectional bursts of bitmap data are transmitted to the graphics accelerator board. The additional buffering logic of PCI may actually get in the way during such transfers.

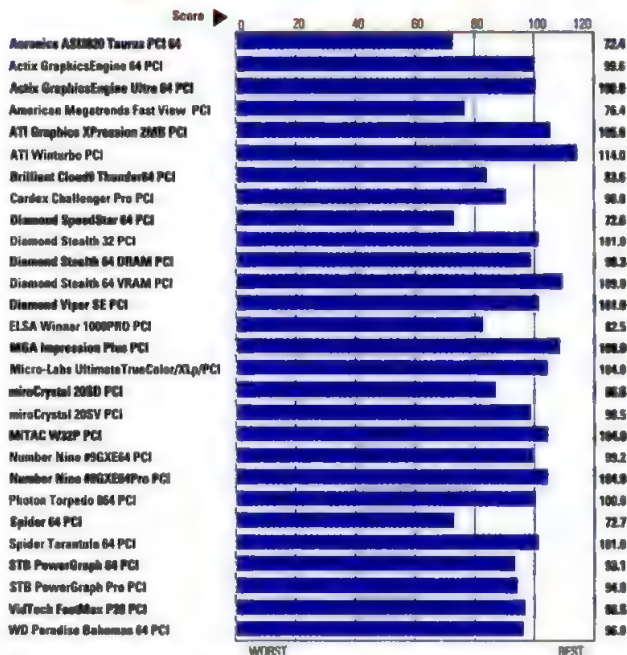
WINSTONE 95 (800-by-600 resolution, 24-bit color)

VLB Boards (486DX2/66)



N/A—Not applicable. The board does not support this resolution and color depth.

PCI Boards (Pentium/90)



Worst Best

How We Tested

PC Labs designed two platforms on which to test the VLB and PCI boards. Our PCI test-bed consisted of HP Vectra XU 5/90C systems based on the 3.3-volt Pentium/90. They had a 256K L2 cache and 16MB of RAM and used Quantum ProDrive LPS 540MB Fast ATA hard disks. In some cases we turned byte-merge off because of incompatibilities between Intel's PCI Neptune chip set and boards based on the Tseng Labs ET4000/W32p and the Cirrus Logic CL-GD5434.

Our VESA local-bus test-bed consisted of Micron 466VL MagServer systems, each with a 256 L2 cache and 16MB of RAM. We used Seagate ST5660A 545MB Fast ATA-2 hard disks.

Each test-bed was configured with DOS 6.2 and Microsoft Windows 3.1 with a 4MB SmartDrive cache. Windows 32-bit disk access was enabled, and we set up a 43MB permanent Windows swap file. We used the 17-inch MAG InnoVision MXP17F and 15-inch NEC MultiSync 4FG color monitors.

Our test-bed software included CorelDRAW 4.0, Microsoft Excel 5.0, Microsoft Word for Windows 6.0, Paradox 4.5, Mustang Software's Qmodem 5.0, and Shapeware Corp.'s Visio 3.0.

To test these boards, we used prerelease versions of PC Bench 9.0, WinBench 95, and Winstone 95. (See Lab Notes in this issue for a complete discussion of our new benchmark tests.) These tests have a margin of error of ± 3 percent, which is apparent in successive runs of the tests.

For the DOS Video tests from **PC Bench**, we normally reduce each product's results to a single score, which is a harmonic mean of the Text and Graphics Mix scores. But because of the irregularities in performance we saw across bus types, we are reporting the Text and Graphics Mix scores separately.

WinBench 95's **Graphics WinMark 95** measures the time it takes to run 13 tests involving 102 different Windows graphics manipulations, including painting lines on the screen and writing to off-screen memory. These are

the same types of operations performed by the applications we run in our Winstone 95 scripts.

The **Winstone 95** benchmark test, like Winstone 94, measures a system's overall Windows performance. Also like its predecessor, Winstone 95 records how long a product takes to complete an application-based script running under Microsoft Test, a software-testing product. It then normalizes that result against a base machine's score. This procedure is repeated for each of 13 applications; the final score, which we report, is a harmonic mean of the results, weighted to reflect the application's market share.

We ran each graphics accelerator board through a testing script that PC Labs prepared for this story. As part of our installation tests, we examined the overall design and production quality of each board and rejected any products that were engineering samples or prototypes. Additionally, we evaluated driver installation and setup, and logged and evaluated all driver firmware, add-ons, and utilities. We tested the board for VESA-compliant screen refresh rates and monitor setup using the Extron SRI 200, a hand-held device that reads the refresh rate directly off the screen.

Among the tests not represented in our charts: Our mainstream usability and driver stability tests included loading a series of Windows applications and DOS apps running in a DOS window. This stress test evaluated color-palette handling across color depths, in addition to speed degradation under limited Windows resources. Torture tests involved running our benchmark test routines continuously for 72 hours.

Digital video tests included performance, compatibility, and stability evaluations. We ran our test .AVI files under Video for Windows 1.1, unless Version 1.1d came with the board. We used Doceo Publishing's Video Compression Sampler 1.1 to load and run Autodesk .FLC, Cinepak, Indeo 3.1 and 3.2, RLE, and Video 1 files and installed and engaged DCI drivers if they were present. —Analysis written by Jeff Mace

Mainstream Graphics Accelerators

benchmark tests, it ranked consistently at or near the top in all Windows tests, and performed acceptably on the DOS tests.

Like its PCI sibling, the \$399 Stealth 64 VRAM VLB ranked at or near the top on all Windows benchmarks. On our 66-MHz 486DX2 test platform, it could not keep up with required video refresh rates.

The \$289 Diamond Stealth 64 DRAM PCI uses the Vision864 graphics engine, 2MB of 70-ns DRAM memory, and an inexpensive S3 SDAC RAMDAC.

The skinny, oblong Stealth 64 DRAM VLB differs from its PCI sibling only in bus type. It ranked within 10 percent of the top boards, even VRAM VL-Bus boards, on all benchmark tests.

The differences between DRAM- and VRAM-based graphics cards were apparent in two areas. The DRAM cards support lower maximum refresh rates, and their overall benchmark performance was a bit lower. If you have a monitor supporting ultra-high refresh rates beyond the VESA standard or you intend to use 16.7 million colors regularly, you would probably be better satisfied with a Stealth VRAM card.

A PASSING GRADE

The Diamond Viper SE PCI, priced at \$399, is based on the Weitek Power 9100 graphics chip and an IBM RAMDAC. It has 2MB of VRAM with sockets to add another 2MB. It has no jumpers or DIP switches to set.

Though different than the InControl software available with the other Diamond cards, the Viper SE Windows utility has many of the same features and offered no unpleasant surprises during our test setup. Note, though, that it doesn't let you preview combinations of resolution and refresh rate.

Both the VLB and PCI Viper SE cards ran our Windows mainstream usability test suite without incident, but the boards could have used some assistance in playing back video at enlarged sizes. The Viper SE PCI was a middle-of-the-road performer on the Windows benchmark tests. Other PCI boards in this evaluation, including Diamond's own Stealth 64 PCI boards, give you more for your dollar than the Viper SE PCI. The Viper

SE VLB, also \$399, turned in the same stable application performance and the same middling benchmark performance. There are better values than the Viper SE VLB among the other boards in our evaluation.

► **Diamond Multimedia Systems Inc.**, 1130 E. Arques Ave., Sunnyvale, CA 94086; 800-468-5846, 408-736-2000; fax, 408-730-5750.

Circle 505 on reader service card

ELSA Inc. (subsidiary of ELSA GmbH)

• **ELSA Winner 1000PRO VLB**

• **ELSA Winner 1000PRO PCI**

BY JAMES KARNEY

With a list price of \$329, mid-range performance, and a lack of advanced features, ELSA's Winner 1000PRO PCI and Winner 1000PRO VLB graphics adapters might best be considered works in progress. The DRAM-based boards use the S3 Vision864 and come in 1MB and 2MB configurations. They offer 1280-by-1024 non-interlaced operation at 75 Hz with 256 colors, and 16.7-million true-color at resolutions of up to 800-by-600 at 70 Hz.

The ELSA Windows driver provides limited functionality. Using the ELSA WINman utility, you can adjust monitor refresh rates from a preset list of displays. You can opt to set up a custom configuration.

The software also lets you operate a virtual desktop and lets you choose between large and small fonts, but doesn't include any other enhancements. With its high price tag, the Winner 1000PRO should offer at least an easy way to change resolution and pixel depth without exiting Windows.

The two cards' benchmark test scores were only average, leaving little justification for their somewhat inflated prices. In practice, though, the speed differences may not be as important as reliable operation for most users.

We had no problems running standard Windows applications or switching between a regular Windows environment and a DOS window. In addition, the ELSA drivers were among the most stable we tested. Switching between applications with different color palettes went smoothly, and without any color shifts. Furthermore, ELSA's drivers were not

memory hogs: We were able to run five applications under Windows without crashing.

PLUGGING IN

Once we installed the Windows driver, we adjusted our configuration to match the desired monitor refresh rates, resolution, and color depth. In installing the DOS driver, though, we had to set the refresh rate manually; the only assistance is a message that warns that exceeding the display's refresh rate might damage the monitor. ELSA is reportedly improving the installation.

The company also bundles drivers for Windows NT, OS/2, and Nextstep. Its AutoCAD drivers have an excellent reputation, but they were not tested for this review. In addition, the Winner 1000PRO boards support the VESA display power management signaling (DPMS) energy-saving feature.

ELSA's Winner 1000PRO PCI and Winner 1000PRO VLB cards lack the polish found in more popular graphics accelerators, and would benefit from a lower price and improved installation utilities and features. Without such improvements, the cards will probably have the greatest appeal in the CAD market, thanks to ELSA's AutoCAD drivers, which offer both productivity and file management enhancements.

► **ELSA Inc. (subsidiary of ELSA GmbH)**, 400 Oyster Point Blvd., #109, South San Francisco, CA 94080; 800-272-3572; 415-615-7799; fax, 415-588-0113.

Circle 506 on reader service card

Genoa Systems Corp.

• **Genoa Hornet VLB**

• **Genoa Phantom 64 VLB**

BY JAMES KARNEY

Genoa Systems Corp. continues its tradition of offering low-cost, general-purpose Windows graphics adapters with its latest offerings, the \$189 Hornet VLB and the \$279 Phantom 64 VLB. Other than the Genoa brand name, about the only thing these two boards share is their use of DRAM. They use different engines and RAMDACs, and offer different features.

The Genoa Hornet is based on the new NCR 77C32BLT GUI engine, and supports a maximum resolution of 1,280-by-1,024 with 256 colors. It can provide



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**HEWLETT
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24-bit true color operation at 800-by-600.

You won't get a lot of features with the Hornet's Windows driver. The Hornet is a basic Windows graphics board, sans fancy options like on-the-fly mode switching and color calibration. You can change the Windows resolution or color depth via a feature called SetRes on the Genoa control panel; but save your work first, since the application will restart Windows to make the change.

The Hornet's installation process is straightforward but has no real elegance. The DOS setup routine copies the Genoa drivers to your hard drive. If you are installing for Windows, the setup routine will automatically load Windows and install the driver. The setup will then prompt you to restart Windows.

The drivers operated properly during our testing, and the Hornet provided reasonable, if not outstanding, performance. The board was slightly above average in our benchmark tests. The bargain-conscious may be tempted, but other boards we tested offer better performance.

THE PHANTOM ADAPTER

The \$279 Genoa Phantom 64 is more upscale. Its 64-bit S3 Vision864 engine can provide 1,600-by-1,200 resolution with 256 colors with 2MB of DRAM installed. The Phantom, like the Hornet, has few advanced Windows amenities. Genoa has provided a virtual desktop utility that provides a 1,280-by-1,024 desktop with 1,024-by-768 monitors.

The Phantom is available in both PCI and VLB versions, but only a VLB model was provided for our evaluation. Installation follows the same two-step process as with the Hornet; we found the drivers to be generally stable. We didn't notice any major problems while running several applications at the same time, but there was slight flickering at the edges of the monitor screen at 1,024-by-768 resolution.

The Phantom 64 offered somewhat better performance than its sibling to match its higher price tag. It ranked near the top of our 800-by-600 8-bit WinBench test, but dropped down to the middle of the pack on the Winstone suite at the same resolution. While these scores offer acceptable speed for general Windows tasks, there are boards in the same price range with more features and comparable or better speed.

Memories of Tomorrow



By Lance Ulanoff

By this time next year, users preparing to purchase their next graphic

accelerator boards could be faced with a mind-boggling selection of video RAM choices, including DRAM, VRAM, EDO VRAM and DRAM (also called EDRAM), MDRAM, RDRAM, SDRAM, and WRAM. Which new memory technologies will offer card manufacturers the best combination of supply, price, and performance?

Among the front runners is EDO (Extended Data Out) VRAM and DRAM. It's the only new memory technology that's currently available from several companies: Micron, Samsung Semiconductor, Toshiba, and other major chip manufacturers. EDO's defining feature is its increased bandwidth, which is a direct result of its overall shortening of the page mode cycle of standard VRAM and DRAM. Overall, EDO chips are approximately 25 percent faster than comparable standard DRAM and VRAM chips. Graphics card vendors already committed to using EDO on their next generation of cards include ATI and Diamond.

Most agree that EDO is an evolutionary step in memory technology because it's basically an extension of current RAM technology, and board vendors will be able to implement it without reengineering the accelerator chip. If you're looking for a revolution, Samsung's WRAM (Window RAM) may fit the bill. Dual-ported like VRAM, WRAM features a number of enhancements specifically geared toward improving graphics performance in any GUI environment. Unlike DRAM, WRAM has a color write-block mode that should enhance screen redraw performance, and a memory design that should facilitate better text-rendering performance.

Like VRAM, WRAM will be expensive (it will cost less than VRAM, but more than DRAM), and may be in short supply, since Samsung, the inventor of the technology, is currently the sole supplier, although the company says it is speaking with other manufacturers who are interested in producing WRAM. Among graphics board manufacturers, few have voiced their commitment to WRAM so far. A couple of exceptions are Matrox and Trident.

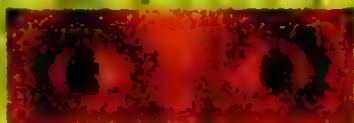
As for the rest of the technologies out there—Rambus's RDRAM, Synchronous DRAM (SDRAM), and many others—vendors have adopted a wait-and-see attitude. Of these two, RDRAM may have the best chance of succeeding. Although Rambus only produces the chip technology and not the actual chips, it has received commitments from memory chip and graphics accelerator manufacturers to use and support Rambus technology in future DRAM-based products.

Like EDO, RDRAM is another incremental technology that advances current DRAM technology by increasing bandwidth. Essentially, Rambus replaces DRAM's traditional page-mode memory with its own interface. Rambus claims that 8-bit DRAM organized according to the company's scheme can perform at approximately 500 megabytes per second (MBps). Current DRAM operates at around 40 MBps on a 16-bit bus.

Another new proprietary memory architecture is Multibank DRAM, or MDRAM. Developed by MoSys, it will be based on several small, independent banks of DRAM. S3, among others, will support MDRAM in its chip sets.

Regardless of which technology vendor or chip manufacturer prevails, competing products, lower prices, and better graphics cards are bound to make users the real winners in this memory war. □

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CIRCLE 181 ON READER SERVICE CARD

Mainstream Graphics Accelerators

Genoa's Hornet VLB and Phantom 64 VLB are inexpensive graphics adapters that work reliably but offer few enhancements. If you are on a tight budget and are willing to trade the latest features for a lower price, these accelerator boards might be worth investigating.

► **Genoa Systems Corp.**, 75 E. Trimble Rd., San Jose, CA 95131; 800-934-3662; 408-432-9090; fax, 408-434-0997.

Circle 507 on reader service card

Hercules Computer Technology Inc.

• Hercules Dynamite Power VLB

BY JAN OZER

The \$299 Hercules Dynamite Power VLB features above-average video performance and a modest software suite in a well-documented package from what was once one of the most illustrious names in graphics. However, the board's operation proved a bit unstable for our liking, which may indicate that the Dynamite Power is not quite a finished product.

Like other boards built around the Tseng Labs ET4000/W32p chip set, the Dynamite Power features 2MB of DRAM for a maximum display resolution of 1280-by-1024 at 8-bit color. Unlike most other Tseng-equipped boards, the Dynamite Power is easy on the eyes, maintaining a 72 Hz refresh rate in all test resolutions.

Pure video performance was mixed. The Dynamite Power performed well in 8-bit mode, averaging in the top quarter of the VLB field and besting all other ET4000/W32p-based products. The situation was reversed in 24-bit mode, where the board dropped into the bottom half of the field, and was dead last against its W32p relatives. The Dynamite Power should prove to be well suited for text-oriented spreadsheet and word processing applications, but ill suited for image editing and similar graphics-intensive tasks.

While product installation was generally smooth, there were some potholes. For example, the Dynamite Power required memory range exclusions for memory managers in the CONFIG.SYS and WIN.INI files. Just the same, Hercules documented the installation directions in the manual, and most users should have no problem getting this done.

The installation program offers a significant variety of monitor presets, and was one of the few that support the NEC

4FG test bed. You configure unsupported monitors in the installation process, where you can access specifications on generic monitors. Otherwise, you must use a command-driven program, which would be too technical for most users.

Windows drivers are installed through the DOS Windows Setup program. The Windows configuration program enables resolution and color depth switching — although you still have to reboot Windows—but little else. Hercules includes a refresh meter to test your monitor's refresh rate and a display power management signaling (DPMS) screen saver to use with DPMS-capable monitors.

Usability testing proved to be the Dynamite Power's undoing. After loading four Windows applications, the board had insufficient memory to shell to DOS, and couldn't complete our tests. During abbreviated tests, the Dynamite Power consistently crashed when operated at or near memory limits. This bodes poorly for consistent, stable field performance, especially for users who multitask.

On a positive note, Hercules' documentation was outstanding, offering both Quick Start and Full Installation instructions, extensive trouble-shooting tips, and other valuable information.

Assuming that Hercules finishes this work in progress and cures the Dynamite Power's memory problems, the board will offer solid performance backed by one of the most venerable companies in the graphics business.

► **Hercules Computer Technology Inc.**, 3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600, 510-623-6030; fax, 510-623-1112.

Circle 508 on reader service card

Matrox Graphics Inc.

• MGA Impression Plus PCI

BY JONATHAN HILL

Matrox Graphics' high-end MGA Impression Plus PCI (\$449) may not be for everyone—you can get better DOS VGA performance in any number of \$100 graphics cards. But this card combines top-tier Windows performance, exceptional value for 3-D enthusiasts, and a daughtercard connection to video acceleration hardware. Further, the utilities and drivers that make up the new unified MGA PowerDesk driver set are among the best in the business.

You can begin installation from a DOS prompt or within Windows. In either case, the program executes a smooth, fully Windows-based installation procedure. All of the MGA productivity features are now Windows-based, including the new MGA Monitor Selection test facility, an MGA Board Information status screen, an MGA Quick Access dialog box to launch various MGA features, and the MGA Control Panel.

On-the-fly resolution switching is enabled through Instant ModeSwitch and the use of Matrox's QCDP drivers, which use 8- or 16-bit dithering to simulate 24-bit color at higher resolutions than the nominal capacity of the board. For the price of a small performance hit, you can hotkey through four configurable resolution and color-depth combinations without restarting Windows.

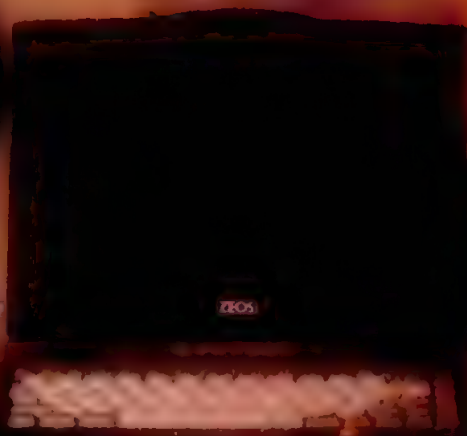
GOOD IMPRESSION

The MGA Impression Plus finished among the top four boards on our WinBench 95 and Winstone 95 tests in 8- and 24-bit color modes. Curiously, the board managed only average performance at 1024-by-768 resolution with 16-bit color; presumably the MGA drivers have not been optimized for that color depth. Thanks to the board's Texas Instruments 175 MHz TVP 3026 RAMDAC, refresh rate stability was top-rate. The MGA Impression Plus exceeded the capability of our MAG InnoVision MXP17F monitors, maintaining a vertical refresh rate in excess of 100 Hz at all color depths and resolutions below 1,152-by-882, and holding steady at 72 Hz in 8-bit color at 1,600-by-1,200.

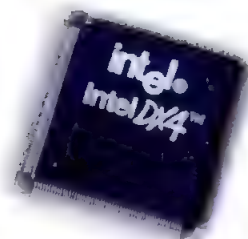
A key feature of the MGA Impression Plus is its support for rendering 3-D Gouraud-shaded triangles in hardware. The uses for 3-D shading have long been limited to applications like Autodesk's 3D Studio, but Matrox is helping to establish and promote 3-D API standards. The company bundles the MGA 3D-Super-Pack CD, which contains 3-D games, demos, and a copy of Criterion Software's RenderWare 3-D development library with the MGA Impression Plus.

The other buzzword in this market is digital video. Matrox provides a DCI driver with the MGA Impression Plus, but the ability of the MGA chip to process video data is rather limited in comparison

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DX4-100	\$2495	\$2795	\$2795	\$2995	\$3095	\$3295
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CIRCLE 151 ON READER SERVICE CARD.

Graphics Accelerator Chip/Board Matrix



By Eryn R. Brown

In addition to benchmark test scores, the type of chip that a board incorporates may influence your graphics

card purchasing decision. Refer to this matrix to find out which chips are integrated into the accelerator boards that interest you.

GRAPHICS ACCELERATOR BOARD	CHIP TYPE	GRAPHICS ACCELERATOR BOARD	CHIP TYPE
Applan Renegade 1280 VLB	Applan ACG98032	Number Nine #9GXE64 VLB	S ³ Vision 864
ATI Graphics XPression 2MB VLB	ATI mach64	Number Nine #9GXE64 PCI	
ATI Graphics XPression 2MB PCI		Photon Torpedo 864 PCI	
ATI Winturbo VLB		STB PowerGraph Pro PCI	
ATI Winturbo PCI		VidTech FastMax P20 PCI	
Boca Voyager VLB	Chips & Technologies	Western Digital Paradise Bahamas 64 PCI	
Spider 256 Cache VLB	64300 Wingine DGX	Actix GraphicsEngine Ultra 64 PCI	S ³ Vision 964
Acronics ASI2000 Orion VLB 64	Citrus Logic CL-GD5434	Diamond Stealth 64 VRAM VLB	
Acronics ASI2020 Taurus PCI 64		Diamond Stealth 64 VRAM PCI	
Diamond SpeedStar 64 PCI		Number Nine #9GXE64Pro VLB	
Orchid Kelvin 64 VLB		Number Nine #9GXE64Pro PCI	
RasterOps Truevision ColorImpact 100 VLB		Spider Tarantula 64 VLB	
Spider 64 PCI		Spider Tarantula 64 PCI	
MGA Impression Plus PCI	Matrox MGA	miroCrystal 20SV VLB	
Brilliant Cloud9 VLB	NCR 77C32BLT	miroCrystal 20SV VLB	
Brilliant Cloud9 Thunder64 PCI		Cardex Challenger32 VLB	Tseng ET4000/W32p
Genoa Hornet VLB		Cardex Challenger Pro PCI	
STB PowerGraph 64 PCI	S ³ Trio64	Diamond Stealth 32 VLB	
Actix GraphicsEngine 64 VLB	S ³ Vision 864	Diamond Stealth 32 PCI	
Actix GraphicsEngine 64 PCI		Hercules Dynamite Power VLB	
Diamond Stealth 64 DRAM VLB		Micro-Labs Ultimate TrueColor/XLp/VLB	
Diamond Stealth 64 DRAM PCI		Micro-Labs Ultimate TrueColor/XLp/PCI	
ELSA Winner 1000PRO VLB		MTAC W32P PCI	
ELSA Winner 1000PRO PCI		American Megatrends Fast View VLB	Weitek Power 9000
Genoa Phantom 64 VLB		American Megatrends Fast View PCI	
miroCrystal 20SD VLB		Diamond Viper SE VLB	Weitek Power 9100
miroCrystal 20SD PCI		Diamond Viper SE PCI	

to the dedicated video accelerators now appearing on the horizon.

Matrox is planning the November 1994 release of a \$369, low-end board. Its maximum resolution will be 1,280-by-1,024 at 8-bit color.

While the MGA Impression Plus is definitely at the high end of the price scale in this review, the card provides considerable added value for your money. Top flight performance, productivity features, and future expandability continue to make MGA the graphics accelerator to watch.

► **Matrox Graphics Inc., 1055 St. Regis Blvd., Dorval, Quebec, Canada H9P2T4; 800-361-1408, 514-685-2630; fax, 514-685-2853.**

Circle 509 on reader service card

Micro-Labs Inc.

- **Micro-Labs Ultimate TrueColor/XLp/VLB**
- **Micro-Labs Ultimate TrueColor/XLp/PCI**

BY JAN OZER

In the ultimate quest for video speed, some users gladly trade creature comforts for raw graphics horsepower. Others prefer the cushioned feel of stable, well-designed installation and configuration programs over the latest graphics speed burner. Unfortunately, the Ultimate TrueColor PCI and VLB graphics boards from Micro-Labs have neither to recommend them.

Priced at \$269 for the VLB version, and \$279 for the PCI, the Ultimate TrueColor boards combine below-average performance with substandard software.

In addition to creating a Micro-Labs driver and utilities directory under DOS manually, you'll have to create command-line arguments in order to set up your monitor. Furthermore, you'll have to go to the Windows Setup program in order to load the Windows drivers.

Finally, the Ultimate TrueColor's display power management signaling (DPMS) utility requires that you copy the DPMS file into the Windows directory and install the screen saver into your Windows Desktop.

Unfortunately, things don't improve once the boards are up and running. Both boards are built around the 32-bit Tseng ET4000/W32p graphics accelerator, which lacks the muscle (except in 800-by-600 with 256 colors) to compete with the

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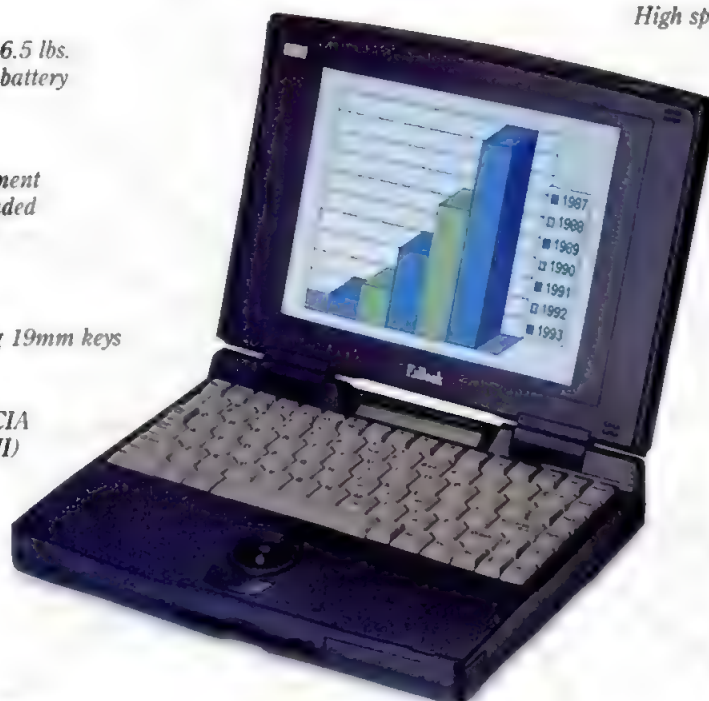
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Mainstream Graphics Accelerators

64-bit chips driving most competitive boards. In our graphics WinBench 95 tests, the Ultimate TrueColor boards' scores averaged in the bottom third of their respective classes.

Overall, the Ultimate TrueColor boards ranked third when measured against the other Tseng-powered products in this review—clear evidence that Micro-Labs didn't waste much time adding value to the basic Tseng drivers. More significantly, the Ultimate TrueColor PCI dropped from 72 Hz to 60 Hz for most Windows benchmark tests, which translates directly into potential eyestrain during long-term operation.

There were two bright spots. First, both boards performed well in the PC Bench tests, with the PCI version leading the field and the VLB version near the top. In addition, both boards were efficient memory managers, and proved to be extremely stable.

Other than that, the Ultimate TrueColor boards were steadfastly unremarkable. They are in essence cookie-cutter boards built around stock chip sets using canned drivers supplied by the graphics chip vendor. Micro-Labs added very little to the equation. Those not seeking a refresher course in DOS operation should look elsewhere to satisfy their graphics needs.

► **Micro-Labs Inc., 204 Lost Canyon Court, Richardson, TX 75080; 214-234-5842; fax, 214-234-5896.**

Circle 510 on reader service card

miro Computer Products Inc.

- **miroCrystal 20SD VLB**
- **miroCrystal 20SD PCI**
- **miroCrystal 20SV VLB**
- **miroCrystal 20SV PCI**

BY JOHN R. QUAIN

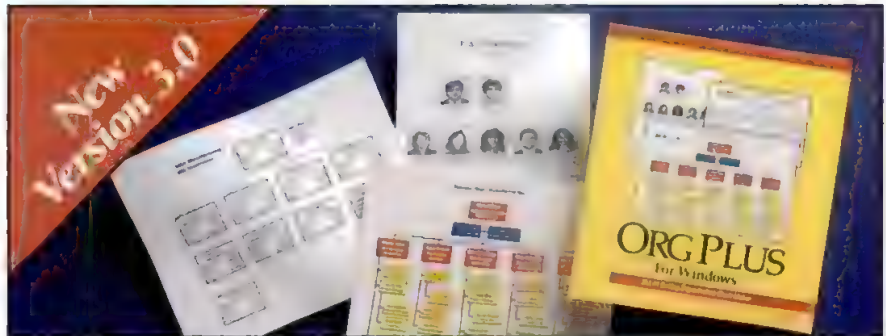
Offering respectable Windows performance and loads of software-selectable features, these four graphics accelerators from German peripheral maker miro Computer Products are aimed at users with slightly differing tastes. The high-end \$399 miroCrystal 20SV PCI and VLB cards are intended for users who need top-notch Windows speed and solid SVGA 24-bit color support. Priced at \$100 less, the miroCrystal 20SD PCI and VLB cards are intended for budget-minded users who still want a little zip in their

Windows graphics, but are willing to sacrifice some 24-bit color performance.

The top pair of miro offerings, the miroCrystal 20SV PCI and VLB cards, are based on the S3 Vision964 fixed-function accelerator and come with 2MB of VRAM. These models are capable of delivering virtually flicker-free vertical refresh rates of up to 100 Hz in noninterlaced 1,024-by-768 mode and 75 Hz in

1,280-by-1,024 mode with 256 colors. At 16.7 million colors in 800-by-600 mode, the miroCrystal 20SVs also produce an eye-pleasing 75-Hz refresh rate, and both offer snappy Windows performance and smoother digital video playback than lower-priced DRAM cards.

The second pair of miro adapters are the PCI and VLB versions of miroCrystal 20SD. These two cards rely on slower but



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CIRCLE 351 ON READER SERVICE CARD

Mainstream Graphics Accelerators

less expensive DRAM and use the S3 Vision864 fixed-function accelerator. Both boards offer the same resolution modes, color depths, and vertical refresh rates as the VRAM versions. What they lack is the 16.7 million-color Windows performance.

In PC Labs' tests, the Vision964-based miroCrystal 20SV VRAM-based boards turned in decent Windows performance. In 8-bit color mode, both boards held their own among in the top half of the contenders. However, in 24-bit color tests, their strengths quickly became evident. In SVGA with 16.7 million colors, the they each managed to place in the top ten among boards of the same bus type.

At lower color requirements, the Vision864-based DRAM versions of the miroCrystal cards turned in nearly identical Winstone and WinBench results compared with their VRAM counterparts. However, the less expensive DRAM pair quickly revealed their weaknesses when the color depth was increased to 24-bits. Comparing the VLB DRAM-based miroCrystal 20SD against the VRAM-

equipped miroCrystal 20VD proved that the latter was approximately 20 percent faster on our 800-by-600, 24-bit color WinBench tests. More dramatically, the PCI version of the VRAM-based 20SV performed 24-bit color operations nearly twice as fast as the less expensive miroCrystal 20SD in PC Labs' WinBench tests.

All of the miro boards offer easy installation programs, which complement their respectable performance. And in rigorous compatibility tests, the only model that we had any trouble with was the miroCrystal 20SD VLB, which encountered some difficulties smoothly playing back digital Video 1 files.

SUITE ADDITIONS

miro includes the same extensive Windows utility suite with each of the boards. The suite includes a DPMS power-saving utility, tint control, and a TV-overscan control for use with a VGA-to-NTSC converter card. A single program allows you to change resolution, color depth, and the Windows font size, while the miroScope feature enables you to zoom in at up to 16

times the screen resolution. For those who like to keep a lot of windows open, there's also a virtual screen applet that lets you bring the screen up to 1,792 by 1,024 pixels (1,536-by-1,024 for the DRAM 20SD models). You can even switch between 640-by-480 and 800-by-600 display modes without rebooting Windows.

Despite the multitude of software features, there are some rough edges. Vertical refresh rates, for example, are determined by setting a monitor selection in a Windows utility. Unfortunately, only MAG and Sony monitors are directly supported, so you either have to choose a specified horizontal refresh rate or set up a special configuration. Furthermore, the rough English translation of the owner's manual is alternately amusing and frustrating, and a couple of dialog boxes still appear in German.

Miro's four boards aren't the benchmark leaders, but they offer consistent performance and stability for a reasonable price. The software features, while not perfect, make these an even more attractive choice.



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- DCI software video acceleration
- Hardware accelerated 3D
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- Includes MGA 3D-SuperPack

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- 2 MB VRAM upgradable to 4 MB
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- Upgradable to the VM-Channel and PowerPlay64
- Hardware accelerated 3D
- MGA PowerDesk and MGA DynaView 2D/3D
- Includes MGA 3D-SuperPack

MGA PowerDesk features for Windows

- Full Windows installation and monitor selection
- Instant ModeSWITCH™ on-the-fly resolution and color depth switching
- Virtual desktop sizes up to 1600 x 1200
- PixelTouch hardware pan & zoom
- QCDP true color dithering
- Center Pop-Up and Center Window
- MaxVIEW
- PanLock
- Quick Access



MGA DynaView™ 2D/3D features for CAD

- Hardware accelerated Gouraud shading, double-buffering² and Z-buffering³
- Real-time 3D movements and rotations
- Dynamic Spy Glass and Bird's Eye views
- Scroll and Zoom bars
- Resizable and repositionable main Window
- Scrollable Text Window
- Programmable pop-up Iconic menus and Tool Strip

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- Three interactive, real-time 3D games from 47-TEX™, Velocity™, and Amorphous Designs™
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- RenderWare 3D software developer's kit from Criterion
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1. 1280x1024 @ 120Hz refresh rate is optional. 2. Double-buffering is optional. 3. Z-buffering is optional. ©1994 All rights reserved. Matrox, Velocity, Amorphous Designs, Criterion, RenderWare, VM-Channel, PowerPlay64, and MGA are trademarks of Matrox Electronics Systems Ltd. 47-TEX is a trademark of 47-TEX. 5. 1280x1024 @ 120Hz refresh rate is optional. 6. 1280x1024 @ 120Hz refresh rate is optional. 7. 1280x1024 @ 120Hz refresh rate is optional. 8. 1280x1024 @ 120Hz refresh rate is optional. 9. 1280x1024 @ 120Hz refresh rate is optional. 10. 1280x1024 @ 120Hz refresh rate is optional. 11. 1280x1024 @ 120Hz refresh rate is optional. 12. 1280x1024 @ 120Hz refresh rate is optional. 13. 1280x1024 @ 120Hz refresh rate is optional. 14. 1280x1024 @ 120Hz refresh rate is optional. 15. 1280x1024 @ 120Hz refresh rate is optional.

PC Magazine (U.S.) June 28, 1994



"Matrox has set the bar now for games on a PC."
Jon Peddie Associates, Sept. 20, 1994, p.753

"Matrox Graphics is once again raising the bar in the graphics accelerator game..."

James Karney, PC Magazine, October 25, 1994

CIRCLE 124 ON READER SERVICE CARD

matrox

► SUMMARY OF FEATURES

Graphics Accelerator Boards

In alphabetical order by company

■ = YES □ = NO

	Acronics Systems Inc.	Acronics Systems Inc.	Actix Systems Inc.	Actix Systems Inc.	Actix Systems Inc.	American Megatrends Inc.	American Megatrends Inc.	Appian Technology Inc.
	ASI2000 Orion VLB 64	ASI2020 Taurus PCI 64	Graphics- Engine 64 VLB	Graphics- Engine 64 PCI	Graphics- Engine Ultra 64 PCI	Fast View VLB	Fast View PCI	Renegade 1280 VLB
List price (tested configuration)	\$269	\$269	\$229	\$229	\$345	\$399	\$399	\$390
Graphics accelerator chip	Cirrus Logic CL-GD5434	Cirrus Logic CL-GD5434	S3 Vision864	S3 Vision864	S3 Vision964	Weitek Power 9000	Weitek Power 9000	Appian AGC98032
Includes video acceleration	□	□	□	□	□	□	□	□
Separate video-playback acceleration chip	□	□	□	□	□	□	□	■
Video-playback chip manufacturer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Cirrus Logic
VGA BIOS manufacturer	Cirrus Logic	Cirrus Logic	Phoenix	Phoenix	Phoenix	Weitek	Weitek	Cirrus Logic
VGA pass-through connector	■	■	■	■	■	■	■	□
Hardware cursor	■	■	■	■	■	■	■	■
Display memory	2MB 70-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM	2MB 60-ns VRAM	2MB 70-ns VRAM	2MB 60-ns VRAM	2MB 80-ns VRAM
Maximum installable memory	2MB	4MB	4MB	4MB	4MB	2MB	2MB	2MB
RAMDAC	On chip	On chip	ATT21C498	ATT21C498	TVP 3025	BT485	BT485	TVP 3010
RAMDAC manufacturer	Cirrus Logic	Cirrus Logic	AT&T	AT&T	TI	Brooktree	Brooktree	TI
Uses DIP switches	□	□	□	□	□	□	□	□
Uses jumpers	□	□	□	□	□	■	□	■
Settings are configurable in an on-board EEPROM	□	□	□	□	□	□	□	□
Display Characteristics								
Maximum noninterlaced graphics resolution (dpi)	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024	1,024 x 768
Maximum number of colors at:								
1,600-by-1,200 resolution	N/A	N/A	256	256	256	N/A	N/A	N/A
1,280-by-1,024 resolution	256	256	256	256	256	256	256	256
1,024-by-768 resolution	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
800-by-600 resolution (Super VGA)	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	65,000
640-by-480 resolution	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Software Features								
Drivers included								
AutoCAD	■	■	■	■	■	■	□	■
Other CAD drivers	MicroStation, 3DStudio	MicroStation, 3DStudio	Generic CADD, Versa CAD	Generic CADD, Versa CAD	Generic CADD, Versa CAD	MicroStation	MicroStation	MicroStation, 3DStudio
Corel Ventura (formerly Ventura Publisher)	■	■	■	■	■	■	■	□
DCI	□	□	□	□	□	□	□	□
Lotus 1-2-3	■	■	■	■	■	■	■	□
Microsoft Word	■	■	■	■	■	■	■	□
OS/2 2.1	■	■	■	■	■	■	■	□
Windows NT	■	■	■	■	■	■	■	■
WordPerfect	■	■	■	■	■	■	■	□
On-the-fly resolution switching								
Proprietary resolution-switching dialog box	■	■	■	■	■	□	□	■
User can change resolution without rebooting Windows	□	□	□	□	□	□	□	□
Zoom	□	□	□	□	□	□	□	□
Largest zoom factor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Virtual display	□	□	□	□	□	□	□	■
Environments	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Windows
Refresh-rate selection utility	■	■	■	■	■	■	■	■
Environments	DOS, Windows	DOS, Windows	DOS, Windows	DOS, Windows	DOS, Windows	Windows	Windows	DOS
User can preview refresh rate	■	■	□	□	□	□	□	□
User can center screen image	■	■	■	■	■	□	■	■
User can change aspect ratio of screen image	□	□	■	■	■	□	□	■
Customer Support								
Technical-support phone number	510-770-3400	510-770-3400	408-986-1625	408-986-1625	408-986-1625	404-263-8181	404-263-8181	800-422-7369
Technical-support hours (eastern time)	12:00-8:00 M-F	12:00-8:00 M-F	11:00-9:00 M-F	11:00-9:00 M-F	11:00-9:00 M-F	8:00-8:00 M-F	8:00-8:00 M-F	11:00-8:00 M-F
BBS number	510-490-8379	510-490-8379	408-970-3719	408-970-3719	408-970-3719	404-246-8780	404-246-8780	206-649-9505
On-line forum	None	None	None	None	None	None	None	CIS
Warranty	5 years	5 years	2 years	2 years	2 years	1 year	1 year	2 years

N/A—Not applicable: The product does not have this feature

* The largest zoom factor depends on the resolution being used

** This forum is available only in the German language

C&T—Chips & Technologies Inc. TI—Texas Instruments Inc.

Mainstream Graphics Accelerators

CONTINUES



ATI Technologies Inc. Graphics XPression 2MB VLB	ATI Technologies Inc. Graphics XPression 2MB PCI	ATI Technologies Inc. Winturbo VLB	ATI Technologies Inc. Winturbo PCI	Boca Research Inc. Boca Voyager VLB	Brilliant Computer Products Cloud9 VLB	Brilliant Computer Products Cloud9 Thunder64 PCI	Cardexpert Technology Inc. Cardex Challenger32 VLB	Cardexpert Technology Inc. Cardex Challenger Pro PCI	Diamond Multimedia Systems Inc. SpeedStar 64 PCI
\$249	\$249	\$369	\$369	\$199	\$195	\$195	\$275	\$275	\$219
ATI mach64	ATI mach64	ATI mach64	ATI mach64	C&T 64300, Wingine DGX	NCR 77C328LT	S3 Vision864	Tseng Labs ET4000/W32p	Tseng Labs ET4000/W32p	Cirrus Logic CL-GD5434
■	■	■	■	□	□	□	□	□	□
□	□	□	□	□	□	□	□	□	□
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ATI	ATI	ATI	ATI	C&T	NCR	Phoenix, S ³	Tseng Labs	Tseng Labs	Diamond
■	■	■	■	■	■	■	■	■	■
2MB 60-ns	2MB 60-ns	2MB 60-ns	2MB 60-ns	2MB 70-ns	2MB 45-ns	2MB 60-ns	2MB 45-ns	2MB 45-ns	2MB 60-ns
DRAM	DRAM	VRAM	VRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM
2MB	2MB	2MB	2MB	2MB	2MB	2MB	2MB	2MB	2MB
STG	STG	68860	68860	On chip	ChronDAC	SDAC	STG	STG	On chip
1702J-132	1702J-132	SpectraDAC	SpectraDAC	C&T	CH8391v	S3	1702J-132	1702J-132	Cirrus Logic
SGS-Thomson	SGS-Thomson	ATI	ATI	ATI	Chrontel	Chrontel	SGS-Thomson	SGS-Thomson	Chrontel
□	□	□	□	□	□	□	□	□	□
□	□	□	□	□	■	■	■	■	■
■	■	■	■	□	□	□	□	□	□
1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
256	256	256	256	N/A	256	256	256	256	256
65,000	65,000	65,000	65,000	256	65,000	65,000	65,000	65,000	65,000
16.7 million	16.7 million	16.7 million	16.7 million	65,000	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
15.7 million	15.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
■	■	■	■	■	■	■	■	■	■
MicroStation, 3DStudio	MicroStation, 3DStudio	MicroStation, 3DStudio	MicroStation, 3DStudio	None	None	MicroStation	None	None	None
■	■	■	■	■	□	□	■	■	□
■	■	■	■	■	□	□	□	□	□
□	□	□	□	■	□	□	■	■	■
■	■	■	■	■	□	□	■	■	■
■	■	■	■	Optional	Optional	Optional	■	■	■
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	□	□	■	■	■
■	■	■	■	■	□	□	□	□	□
5x	5x	5x	5x	N/A	N/A	N/A	N/A	N/A	N/A
■	■	■	■	□	□	□	□	□	□
Windows	Windows	Windows	Windows	N/A	N/A	N/A	N/A	N/A	N/A
■	■	■	■	■	■	■	■	■	■
DOS Windows	DOS Windows	DOS Windows	DOS Windows	Windows	DOS Windows	DOS	DOS Windows	DOS Windows	Windows
■	■	■	■	□	□	□	■	■	□
■	■	■	■	■	■	□	□	□	□
■	■	■	■	□	□	□	□	□	□
905 882 2626	905 882 2626	905 882 2626	905 882 2626	407 241 8088	408 942 3315	408 942 3315	408 748 1931	408 748 1931	408 736 2000
9:00-7:00 M-F	9:00-7:00 M-F	9:00-7:00 M-F	9:00-7:00 M-F	8:00-6:00 M-F 10:00-2:00 Sat	11:30-8:30 M-F	11:30-8:30 M-F	12:00-8:30 M-F	12:00-8:30 M-F	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat
■	■	■	■	■	■	■	■	■	■
CIS	CIS	CIS	CIS	CIS, GenIE	None	None	None	None	AOL, CIS
5 years	5 years	5 years	5 years	5 years	2 years	2 years	3 years	3 years	5 years

GRAPHICS

Mainstream Graphics Accelerators

S U M M A R Y O F F E A T U R E S

In alphabetical order by company

■ = YES □ = NO

	Diamond Multimedia Systems Inc. Stealth 32 VLB	Diamond Multimedia Systems Inc. Stealth 32 PCI	Diamond Multimedia Systems Inc. Stealth 64 DRAM VLB	Diamond Multimedia Systems Inc. Stealth 64 DRAM PCI	Diamond Multimedia Systems Inc. Stealth 64 VRAM VLB	Diamond Multimedia Systems Inc. Stealth 64 VRAM PCI	Diamond Multimedia Systems Inc. Viper SE VLB	Diamond Multimedia Systems Inc. Viper SE PCI
List price (tested configuration)	\$199	\$199	\$289	\$289	\$399	\$399	\$399	\$399
Graphics accelerator chip	Tseng Labs ET4000/W32p	Tseng Labs ET4000/W32p	S3 Vision 864	S3 Vision 864	S3 Vision964	S3 Vision 964	Weitek Power 9100	Weitek Power 9100
Includes video acceleration	□	□	□	□	□	□	□	□
Separate video-playback acceleration chip	□	□	□	□	□	□	□	□
Video-playback chip manufacturer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VGA BIOS manufacturer	Diamond	Diamond	Diamond	Diamond	Diamond	Diamond	Diamond	Diamond
VGA pass-through connector	■	■	■	■	■	■	■	■
Hardware cursor	■	■	■	■	■	■	■	■
Display memory	2MB 60-ns DRAM	2MB 60-ns DRAM	2MB 60-ns DRAM	2MB 70-ns DRAM	2MB 60-ns VRAM	2MB 60-ns VRAM	2MB 70-ns VRAM	2MB 70-ns VRAM
Maximum installable memory	2MB	2MB	2MB	2MB	4MB	4MB	4MB	4MB
RAMDAC	STG 1702J-13Z	STG 1702J-13Z	SDAC	SDAC	BT485	BT485	RGB525	RGB525
RAMDAC manufacturer	SGS-Thomson	SGS-Thomson	S3	S3	Brooktree	Brooktree	IBM	IBM
Uses DIP switches	□	□	□	□	□	□	□	□
Uses jumpers	□	□	□	□	□	□	■	□
Settings are configurable in an on-board EEPROM	□	□	□	□	□	□	□	□
Display Characteristics								
Maximum noninterlaced graphics resolution (dpi)	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200
Maximum number of colors at:								
1,600-by-1,200 resolution	N/A	N/A	N/A	N/A	N/A	N/A	256	256
1,280-by-1,024 resolution	256	256	256	256	256	256	256	256
1,024-by-768 resolution	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
800-by-600 resolution (Super VGA)	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
640-by-480 resolution	18.7 million	18.7 million	18.7 million	18.7 million	18.7 million	18.7 million	18.7 million	18.7 million
Software Features								
Drivers included								
AutoCAD	■	■	■	■	■	■	■	■
Other CAD drivers	None	None	MicroStation	MicroStation	MicroStation	MicroStation	MicroStation, 3DStudio	MicroStation, 3DStudio
Corel Ventura (formerly Ventura Publisher)	■	■	□	□	□	□	□	□
DCI	□	□	■	■	■	■	□	□
Lotus 1-2-3	■	■	■	■	■	■	□	□
Microsoft Word	□	□	□	□	□	□	□	□
OS/2 2.1	■	■	■	■	■	■	■	■
Windows NT	■	■	■	■	■	■	■	■
WordPerfect	■	■	■	■	■	■	□	□
On-the-fly resolution switching:								
Proprietary resolution-switching dialog box	■	■	■	■	■	■	■	■
User can change resolution without rebooting Windows	□	□	■	■	■	■	■	■
Zoom	■	■	■	■	■	■	□	□
Largest zoom factor	1.4x	1.4x	1.25x	1.25x	1.25x	1.25x	N/A	N/A
Virtual display	■	■	■	■	■	■	□	□
Environments	Windows	Windows	Windows	Windows	Windows	Windows	N/A	N/A
Refresh-rate selection utility	■	■	■	■	■	■	■	■
Environments	Windows	Windows	DOS, Windows	DOS, Windows	DOS, Windows	DOS, Windows	Windows	Windows
User can preview refresh rate	□	□	□	□	□	□	□	□
User can center screen image	□	□	□	□	□	□	□	□
User can change aspect ratio of screen image	□	□	□	□	□	□	□	□
Customer Support								
Technical-support phone number	408-736-2000	408-736-2000	408-736-2000	408-736-2000	408-736-2000	408-736-2000	408-736-2000	408-736-2000
Technical-support hours (eastern time)	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.
BBS number	408-524-9301	408-524-9301	408-524-9301	408-524-9301	408-524-9301	408-524-9301	408-524-9301	408-524-9301
On-line forum	AOL, CIS	AOL, CIS	AOL, CIS	AOL, CIS	AOL, CIS	AOL, CIS	AOL, CIS	AOL, CIS
Warranty	5 years	5 years	5 years	5 years	5 years	5 years	5 years	5 years

N/A—Not applicable: The product does not have this feature

* The largest zoom factor depends on the resolution being used

** This forum is available only in the German language

C&T—Chips & Technologies Inc. TI—Texas Instruments Inc.

GRAPHICS

Mainstream Graphics Accelerators

CONTINUES

ELSA Inc.	ELSA Inc.	Genoa Systems Corp.	Genoa Systems Corp.	Hercules Computer Technology Inc.	Matrox Graphics Inc.	Micro-Labs Inc.	Micro-Labs Inc.	miro Computer Products Inc.	miro Computer Products Inc.
Winner 1000PRO VLB	Winner 1000PRO PCI	Hornet VLB	Phantom 54 VLB	Dynamite Power VLB	MGA Impression Plus PCI	Ultimate TrueColor/ XLP/ VLB	Ultimate TrueColor/ XLP/ PCI	miroCrystal 20SD VLB	miroCrystal 20SD PCI
\$329	\$329	\$189	\$279	\$299	\$449	\$269	\$279	\$299	\$299
S3 Vision864	S3 Vision864	NCR 77C32BLT	S3 Vision864	Tseng ET4000/W32p	Matrox MGA	Tseng ET4000/W32p	Tseng ET4000/W32p	S3 Vision864	S3 Vision864
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ELSA	ELSA	NCR	Phoenix	Tseng Labs	LSI Logic	Tseng Labs	Tseng Labs	S3, miro	S3, miro
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
2MB 70-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM	2 MB 60-ns DRAM	2 MB 60-ns VRAM	2MB 45-ns DRAM	2MB 45-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM
2MB	2MB	2MB	2MB	2MB	4MB	2MB	2MB	2MB	2MB
ATT21C498	ATT21C498	MU9C9910V	SDAC	STG 1702J-13Z	TVP 3026	STG 1702J-13Z	STG 1702J-13Z	SDAC	SDAC
AT&T	AT&T	MUSIC	S3	SGS-Thomson	TI	SGS-Thomson	SGS-Thomson	S3	S3
☒	☐	☐	☐	☐	☐	☐	☐	☐	☐
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☒	☒	☐	☐	☐	☒	☐	☐	☐	☐
1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024	1,408 x 1,024	1,408 x 1,024
N/A	N/A	N/A	256	N/A	256	N/A	N/A	N/A	N/A
☒	256	256	256	256	256	256	256	☒	256
256	256	256	65,000	65,000	65,000	65,000	65,000	65,000	65,000
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
None	None	None	Generic CADD	3DStudio	MicroStation	MicroStation, 3DStudio	MicroStation, 3DStudio	MicroStation	MicroStation
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☐	☐	☐	☐	☐	☒	☐	☐	☒	☒
N/A	N/A	N/A	N/A	N/A	4x	N/A	N/A	4x	4x
☒	☒	☒	☒	☐	☒	☐	☐	☒	☒
Windows	Windows	Windows	Windows	N/A	Windows	N/A	N/A	Windows	Windows
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
DOS, NeXT, OS/2, Windows	DOS, NeXT, OS/2, Windows	DOS, Windows	DOS, Windows	DOS	OS/2, Windows, Windows NT	DOS	DOS	DOS, Windows	DOS, Windows
☒	☒	☒	☒	☐	☒	☐	☐	☒	☐
☒	☒	☒	☒	☐	☒	☒	☒	☐	☐
☐	☐	☒	☒	☐	☒	☐	☐	☒	☐
800-272-3572	800-272-3572	408-432-8324	408-432-8324	510-623-6050	514-685-0270	214-234-5842	214-234-5842	800-249-6476	800-249-6476
11:00-8:00 M-F	11:00-8:00 M-F	10:30-8:30 M-F	10:30-8:30 M-F	9:00-9:00 M-F	8:30-6:00 M-F	9:30-6:30 M-F, 11:00-3:00 Sat.	9:30-6:30 M-F, 11:00-3:00 Sat.	11:00-8:00 M-F	11:00-8:00 M-F
415-615-5862	415-615-5862	408-943-1231	408-943-1231	510-623-7449	514-685-6008	None	None	415-855-9944	415-855-9944
CIS**	CIS**	CIS	CIS	CIS	CIS	CIS	CIS	CIS**	CIS**
3 years	3 years	2 years	2 years	2 years	2 years	3 years	3 years	2 years	2 years

IT'S LIKE YOUR FAVORITE JUST CAME BACK



Really, the way the Microsoft® Natural Keyboard™ fits you, it would be more accurate to ask you to

try it on than to try it out.

What we have here is an entirely new kind of keyboard—a design that fits you



like your most comfortable clothes. And promotes

a more natural posture for comfortable computing.

But there's much more to say about this keyboard. After all, it's the result of extensive ergonomic and usability research.

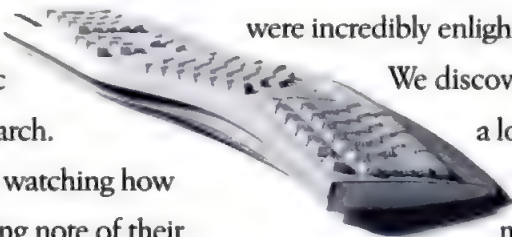
We started by watching how people work, taking note of their



natural body positions. How they type. And how they use Windows.™

Our findings, to be honest, were incredibly enlightening.

We discovered there's a lot of room for improvement in the



standard typewriter-keyboard. And that it could fit today's computer environment better than it currently does.



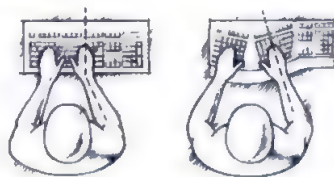
So we proceeded with a redesign. The result? A responsibly designed, split-keypad, gently

RITE PAIR OF JEANS AS A KEYBOARD.



sloping keyboard that fits more closely to the natural positions of your hands and wrists. And one that is more comfortable, if a bit odd-looking.

With this innovative new design, we were able to encourage a straighter positioning of the wrist. Which helps to relax the



The Microsoft Natural Keyboard fits you, not the other way around.

forearm. Which then helps to relax the shoulder. All of which makes for a more natural typing position.

And then we priced the Natural Keyboard to fit your budget just as well as it fits your hands.

But we simply couldn't stop

there. So we gave the keys a nice, soft touch and feel.

What's more, new keys and software simplify access to the Windows operating system. Like three new Windows function

keys, a simple keyboard manager and mouse cursor accelerators.

Suffice it to say, it's like nothing you've ever gotten your hands on.

To experience the Microsoft Natural Keyboard for yourself, simply pay a visit to your local computer retailer. And slip one on. You won't believe how comfortable it feels.



And you won't even have to wait for a dressing room.

Microsoft

GRAPHICS

Mainstream Graphics Accelerators

SUMMARY OF FEATURES

In alphabetical order by company

■ = YES □ = NO

	miro Computer Products Inc.	miro Computer Products Inc.	MITAC USA	Number Nine Computer Corp.	Number Nine Computer Corp.	Number Nine Computer Corp.	Number Nine Computer Corp.	Orchid Technology
	miroCrystal 20SV VLB	miroCrystal 20SV PCI	MITAC W32P PCI	#9GXE64 VLB	#9GXE64 PCI	#9GXE64- Pro VLB	#9GXE64- ProPCI	Kelvia 64 VLB
List price (tested configuration)	\$399	\$399	\$179	\$299	\$299	\$399	\$399	\$325
Graphics accelerator chip	S3 Vision964	S3 Vision964	Tsang ET4000/W32p	S3 Vision864	S3 Vision864	S3 Vision964	S3 Vision964	Cirrus Logic CL-GD5434
Includes video acceleration	□	□	□	□	□	□	□	□
Separate video-playback acceleration chip	□	□	□	□	□	□	□	□
Video-playback chip manufacturer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VGA BIOS manufacturer	S3, miro	S3, miro	Tsang Labs	Number Nine	Number Nine	Number Nine	Number Nine	Cirrus Logic
VGA pass-through connector	■	■	■	■	■	■	■	■
Hardware cursor	■	■	■	■	■	■	■	■
Display memory	2MB 70-ns VRAM	2MB 70-ns VRAM	2 MB 70-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM	2 MB 70-ns VRAM	2MB 70-ns VRAM	2MB 70-ns DRAM
Maximum installable memory	2MB	2MB	2MB	2MB	2MB	4MB	4MB	2MB
RAMDAC	BT485	BT485	CH8398	ATT21C498	ATT21C498	TVP 3025	TVP 3025	On chip
RAMDAC manufacturer	Brooktree	Brooktree	Chrontel	AT&T	AT&T	TI	TI	Cirrus Logic
Uses DIP switches	□	□	□	□	□	□	□	□
Uses jumpers	□	□	□	□	□	□	□	□
Settings are configurable in an on-board EEPROM	□	□	□	□	□	□	□	□
Display Characteristics								
Maximum noninterlaced graphics resolution (dpi)	1,408 x 1,024	1,408 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
Maximum number of colors at:								
1,600-by-1,200 resolution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,280-by-1,024 resolution	256	256	256	256	256	256	256	256
1,024-by-768 resolution	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
800-by-600 resolution (Super VGA)	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
640-by-480 resolution	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Software Features								
Drivers included								
AutoCAD	■	■	■	■	■	■	■	■
Other CAD drivers	MicroStation	MicroStation	None	MicroStation, 3DStudio	MicroStation, 3DStudio	MicroStation, 3DStudio	MicroStation, 3DStudio	3DStudio
Corel Ventura (formerly Ventura Publisher)	□	□	■	□	□	■	■	□
DCI	□	□	□	□	□	□	□	□
Lotus 1-2-3	□	□	■	□	□	□	□	■
Microsoft Word	□	□	□	□	□	■	■	■
OS/2 2.1	■	■	■	Optional	Optional	Optional	Optional	■
Windows NT	■	■	■	■	■	■	■	■
WordPerfect	□	□	■	□	□	■	■	■
On-the-fly resolution switching:								
Proprietary resolution-switching dialog box	■	■	■	■	■	■	■	■
User can change resolution without rebooting Windows	■ (except in 640- by-480 and 800- by-600 modes)	■ (except in 640- by-480 and 800- by-600 modes)	□	□	□	□	□	□
Zoom	■	■	□	■	■	■	■	■
Largest zoom factor	4x	4x	N/A	5x	5x	5x	5x	2x
Virtual display	■	■	□	■	■	■	■	■
Environments	Windows	Windows	N/A	Windows, Unix	Windows, Unix	Windows, Unix	Windows, Unix	Windows
Refresh-rate selection utility	■	■	■	■	■	■	■	■
Environments	DOS, Windows	DOS, Windows	DOS	Windows	Windows	Windows	Windows	DOS, Windows
User can preview refresh rate	□	□	□	■	■	■	■	■
User can center screen image	□	□	□	■	■	■	■	■
User can change aspect ratio of screen image	□	□	□	□	□	□	□	□
Customer Support								
Technical-support phone number	800-249-6476	800-249-6476	800-285-9874	800-438-6463	800-438-6463	800-438-6463	800-438-6463	510-683-0323
Technical-support hours (eastern time)	11:00-8:00 M-F	11:00-8:00 M-F	9:30-8:30 M-F	8:00-8:00 M-F	8:00-6:00 M-F	8:00-8:00 M-F	8:00-6:00 M-F	10:00-8:00 M-F
BBS number	415-855-9944	415-855-9944	None	617-862-7502	617-862-7502	617-862-7502	617-862-7502	510-683-0327
On-line forum	CIS**	CIS**	None	None	None	None	None	CIS
Warranty	2 years	2 years	1 year	5 years	5 years	5 years	5 years	4 years

N/A—Not applicable. The product does not have this feature

* The largest zoom factor depends on the resolution being used

** This forum is available only in the German language

C&T—Chips & Technologies Inc. TI—Texas Instruments Inc.

Mainstream Graphics Accelerators

ENDS

Personal Computer Graphics Corp.	RasterOps Corp.	Spider Graphics Inc.	Spider Graphics Inc.	Spider Graphics Inc.	Spider Graphics Inc.	STB Systems Inc.	STB Systems Inc.	VidTech Microsystems Inc.	Western Digital Corp.
Photon Torpedo 64 PCI	Truevision Color-Impact 100 VLB	Spider 256 Cache VLB	Spider 64 PCI	Tarantula 64 VLB	Tarantula 64 PCI	PowerGraph 64 PCI	PowerGraph Pro PCI	FastMax P20 PCI	Paradise Bahamas 64 PCI
\$237	\$219	\$240	\$364	\$250	\$359	\$199	\$239	\$235	\$299
S3 Vision864	Cirrus Logic CL-GD5434	C&T 64300, Wingine DGX	Cirrus Logic CL-GD5434	S3 Vision964	S3 Vision964	S3 Trio64	S3 Vision864	S3 Vision864	S3 Vision864
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PCG	Quantel	Spider	Spider	Spider	Spider	STB	STB	S3	S3
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
2MB 60-ns DRAM	2MB 70-ns DRAM	2MB 70-ns DRAM	4MB 80-ns DRAM	2MB 70-ns VRAM	2MB 70-ns VRAM	2MB 45-ns DRAM	2 MB 45-ns DRAM	2MB 70-ns DRAM	2MB 60-ns DRAM
4MB	2MB	2MB	4MB	4MB	4MB	2MB	2 MB	2MB	2MB
On chip	On chip	On chip	On chip	BT485	BT485	On chip	SDAC	SDAC	SDAC
S3	Cirrus Logic	C&T	Cirrus Logic	Brooktree	Brooktree	S3	S3	S3	S3
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☒	☒	☐	☐	☒	☒	☐	☐	☐	☐
☒	☐	☒	☐	☐	☐	☒	☒	☐	☐
1,600 x 1,200	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200
256	N/A	N/A	N/A	65,000	65,000	N/A	N/A	256	256
256	☒	N/A	65,000	65,000	65,000	256	256	256	256
65,000	65,000	256	65,000	65,000	65,000	65,000	65,000	65,000	65,000
16.7 million	16.7 million	65,000	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Generic CADD, MicroStation	3DStudio	3DStudio	3DStudio	3DStudio	3DStudio	MicroStation	MicroStation	MicroStation, 3DStudio	MicroStation
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☐	☒	☒	☒	☒	☒	☒	☒	☒	☐
N/A	N/A	N/A	N/A	N/A	N/A	12x	12x	4x	N/A
☐	☐	☒	☒	☒	☒	☒	☒	☐	☐
N/A	N/A	Windows	Windows	Windows	Windows	Windows	Windows	N/A	N/A
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
DOS	Windows	Windows	Windows	Windows	Windows	DOS, Windows	DOS, Windows	Windows, Windows NT	DOS
☐	☒	☒	☒	☒	☒	☐	☐	☐	☐
☒	☒	☒	☒	☒	☒	☐	☐	☐	☐
☐	☐	☒	☒	☒	☒	☐	☐	☐	☐
800-836-8324	800-729-2656	408-526-0535	408-526-0535	408-526-0535	408-526-0535	800-234-4334	800-234-4334	800-752-8033	800-832-4778
12:00-8:00 M-F	8:00-7:00 M-F	12:30-9:00 M-F	12:30-9:00 M-F	12:30-9:00 M-F	12:30-9:00 M-F	9:00-7:00 M-F	9:00-7:00 M-F	8:30-7:00 M-F	11:00-6:00 M-Th, 11:00-8:00 F
310-394-2562	317-594-2993	408-526-1219	408-526-1219	408-526-1219	408-526-1219	214-437-9615	214-437-9615	612-633-3301	714-753-1234
None	AOL, CIS	None	None	None	None	☒	CIS	None	None
5 years parts, 1 year labor	Lifetime (limited)	2 years	2 years	2 years	2 years	Lifetime	Lifetime	5 years	3 years

Introducing 1200 dpi printing from Lexmark. We're not re-inventing the wheel. Just the laser, the toner and the print quality.

The new Optra: extraordinary laser printing. At ordinary laser prices. Lexmark invented the 600 dpi standard. Now we're surpassing it with the Optra™ family of high-performance, network-ready laser printers. The first desktop printers with true 1200 x 1200 dpi* printing. That's four times the sharpness of an ordinary 600 dpi printer.



The Optra's sleek exterior merely reflects the technical advances inside. Lexmark's print engine has been redesigned from the ground up. Even the toner has been reformulated. PostScript™ Level 2 and enhanced PCL®5 emulations are standard. The result: incredibly sharp graphics and



beautiful, crisp text from virtually any application.

The Optra also delivers superior network connectivity and support. Lexmark's MarkVision™ bidirectional printer utility even lets users and LAN managers



control and configure every Optra printer, and monitor job statistics from Windows.™

For more information about the Optra family

from Lexmark, a former division of IBM, call
1 800 891-0399, ext 10.

The new 1200 dpi Optra. It's the first printer of its kind. And another first from Lexmark.

LEXMARK™

ADVANCING THE ART OF PRINTING
CIRCLE 100 ON READER SERVICE CARD

endorsement of any product or service. NetWare is a registered trademark of Novell, Inc. Windows is a trademark of Microsoft Corporation. PCL is a registered trademark of Hewlett-Packard Company. PostScript is a trademark

Mainstream Graphics Accelerators

► **miro Computer Products Inc.,** 955 Commercial St., Palo Alto, CA 94303; 800-249-6476, 415-855-0940; fax, 415-855-9004.

Circle 511 on reader service card

MiTAC USA • MiTAC W32P PCI

BY BEN MYERS

The \$179 MiTAC W32P PCI is a small graphics board with what appears to be equally small ambitions. It provides relatively generic functionality and average benchmark performance.

Like other boards that use the Tseng Labs ET4000/W32p graphics engine, the MiTAC W32P uses 16-bit wide, 70-ns DRAM memory, so it requires only four chips to make up its 2MB of memory. The card is switchless and jumperless, but it has a kind of a retro-rough feel to it, because many of its hardware components are soldered.

The documentation for the MiTAC W32P, which is generally sketchy, doesn't tell you that there are Windows NT and OS/2 drivers on the accompanying software diskettes; this information is only in the READ.ME file. Furthermore, in the Windows program that installs the supporting software, we found cryptic numeric codes displayed along with the explanations in the program's dialog boxes.

The MiTAC Command Center is a bare-bones program for changing resolution and color depth. It doesn't give you any latitude in selecting the best refresh rate for your monitor. The single set of default refresh rates will probably work with almost any monitor, because they are quite slow, well below the VESA standards. The Command Center exits from and restarts Windows to change to any new resolution.

You need to use the DOS VMODE utility to operate your monitor at higher refresh rates. This is a DOS command line utility with arcane command-line arguments. Aided by VMODE, the MiTAC W32P permits refresh rates of no more than 72 Hz at 640-by-480 and 800-by-600, and 70 Hz at 1024-by-768 and 1280-by-1024.

The MiTAC W32P ran our mainstream

usability test script without incident. It couldn't maintain the required 30-frames-per-second (fps) playback rate of an Indeo video clip, managing only 19 fps. The board turned in respectable Winstone benchmark results and high DOS benchmark numbers but ranked among the lowest in WinBench.

MiTAC has no BBS and doesn't post the latest drivers on CompuServe or any other on-line service. If you can find them, it is likely that the generic drivers supplied by Tseng Labs for its ET4000/W32p chip will work just fine given the basic nature of this product.

Though the MiTAC W32P is the lowest-priced PCI board in our evaluation, its overall quality, features, and capabilities are quite limited compared to boards that are only slightly more expensive.

► **MiTAC USA,** 3797 Spinnaker Court, Fremont, CA 94538; 800-285-9874, 510-440-3733; fax, 510-440-3604.

Circle 512 on reader service card



Number Nine Computer Corp.

- Number Nine #9GXE64 VLB
- Number Nine #9GXE64 PCI
- Number Nine #9GXE64Pro VLB
- Number Nine #9GXE64Pro PCI

BY JONATHAN HILL

Number Nine's products aren't the absolute leaders in benchmark perfor-

mance, but they continue to provide outstanding features and usability. The PCI- and VL-bus versions of the #9GXE64 (\$299) and #9GXE64Pro (\$399) share a unified driver set that includes support for extremely high refresh rates; they also include improved HawkEye for Windows utilities.

Number Nine provides a well designed Windows-based installation program to set up the drivers and utilities. The software informs you that it intends to copy the files into a directory of your choice, modify and back up your WIN.INI and SYSTEM.INI, create a Program Manager group, and save the new settings in a file. Once installed, the HawkEye control panel provides access to several utilities. One, Hot Mouse, lets you assign mouse clicks or hot keys to any of the other utilities.

If you can't find your monitor in the Monitor Adjustment selection utility, you can create a custom configuration for your system by selecting a refresh rate from the pull-down menu and clicking the size and position arrows within the Monitor Adjustment screen. An automatic test facility lets you tweak the new refresh rate if necessary until you find an acceptable match between your monitor and the card, saving the setting locks in the centered, sized screen for that resolution. The HawkEye Resolution Exchange feature lets you repeat the process for each resolution.

In addition to resolution and color-depth selection, Resolution Exchange lets you manipulate the virtual display while providing for automatic font association. The latter feature works with your monitor selection to appropriately configure the font size for each resolution. All of the changes made with the Resolution Exchange require a Windows restart to take effect.

Although the S3 Vision864-based #9GXE64 and the S3 Vision964-equipped #9GXE64Pro both support generally high refresh rates, the #9GXE64 that we tested had problems holding a VESA-compliant 72 Hz in 24-bit color mode at a resolution of 800 by 600 pixels. Lower color depths were no problem: At 800 by 600 pixels using 16-bit color, the board ran fine at a

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Mainstream Graphics Accelerators

refresh rate of 100 Hz. Also, the #9GXE64 is one of the few DRAM boards that supports 1280-by-1024 resolution at a refresh rate of 76 Hz. The VRAM-based #9GXE64Pro was even more impressive, providing a vertical refresh rate in excess of 100 Hz at all resolutions below 1280 by 1024 pixels.

VARIABLES

The #9GXE Status feature provides useful information about the installed board, including the current resolution and color depth, memory configuration, graphics chip type, driver revision, RAMDAC type, and BIOS. You can enable or disable acceleration of various types of functions from within the #9GXE Status screen, including Source Caching, Font Caching, Polygon Support, Pattern Patching, and Memory Mapped I/O.

The Place Windows and StopBox utilities enhance the usefulness of the virtual display. Place Windows is a nice attempt at a workaround for an irritating aspect of Windows 3.1x. In general, when a virtual screen is enabled, pop-up mes-

sages and "child" menus frequently appear in an off-screen section of the display, leaving you panning around the screen to find a lost "OK" button. Place Windows centers such messages in the visible part of the screen. The utility works well with nonsizable message boxes like Print dialogs, but sizable pop-up windows resize themselves to fill the visible screen when the utility is enabled. To work around this, you can assign a Hot Mouse key or click to the Place Windows option and enable it when opening a new app but disable it when using the virtual desktop view.

The Stop Box is a simpler feature. In combination with the Hot Mouse utility, it lets you temporarily disable panning across the virtual display.

Other HawkEye features include the Chameleon Cursor, which lets you adjust the size and color of the mouse cursor; Color Perfect, a gamma correction utility; and #9Energy Saver, which enables the #9GXE DPMS features. Another utility, Zoom, was not enabled in the software revision that we received.

Performance differences between the S3 Vision864, DRAM-based #9GXE64 cards and the S3 Vision964, VRAM-based #9GXEPro boards are minor except at high color depths. Even in 24-bit color mode, however, the main advantage of the VRAM boards is their ability to sustain exceptionally high refresh rates. None of the boards did poorly on the Winstone, WinBench, or PC Bench tests: the PCI and VLB versions of the #9GXEPro performed, on the average, nearly as well as the fastest boards on almost every test. In concert with their excellent features, that performance warrants a hearty recommendation for these mid-priced boards. The #9GXE64 can be found for less than \$250 on the street, a good buy if you don't spend much time using 24-bit color. If you do plan to work in true color mode, you'd be better off spending an extra hundred dollars for the #9GXE64Pro and pairing it with a monitor that can handle its high refresh rates. Your eyes will thank you, and you'll appreciate the boards' features and attention to detail.

■ DCI: Driving Multimedia Forward



By Kathleen Caster
To insure faster video playback in Windows, Intel and Microsoft recently released a new device driver

specification, called DCI (Display Control Interface). In response, graphics card vendors are busily implementing DCI support in their boards and drivers.

DCI's purpose is two-fold. First, it provides a way for system services to write directly to the video hardware for faster playback. The DCI Manager, which sits at the same level as GDI (Graphics Device Interface), sends video calls directly to the video hardware; it has the GDI process calls when the video hardware is busy. Second, DCI accelerates multimedia features—such as color-space conversion, interpolation, and image scaling—if the video chip also supports them. (For more information on DCI, see the Trends section of *PC Maga-*

zine, November 22, 1994.)

The most immediate plan for vendors is to issue updated drivers. Western Digital has already shipped updated drivers, and ATI, Number Nine, and others are expected to do the same. We review several DCI-supported boards in this roundup.

The second solution, which is more complicated and ultimately more beneficial, is to ship boards with chips that have hardware support for DCI. Some chips, for example, offer color-space conversion—that is, conversion of analog YUV signals into digital RGB signals—and DCI can accelerate this process by handling it directly on the video card. Currently, the procedure is handled slowly by a software-based codec. (While pixel-intensive functions will be done in the video hardware with DCI, computation and algorithms will still be in the CPU.)

The S3 Trio32, Trio64 and Vision866, 868, and 968 chips and Tseng Labs'

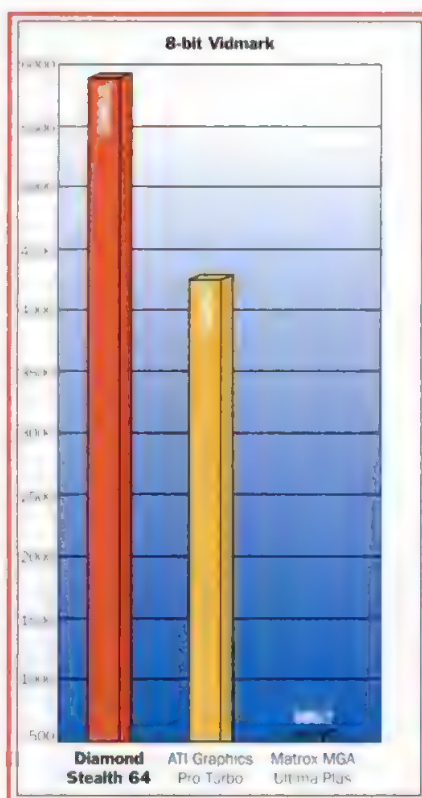
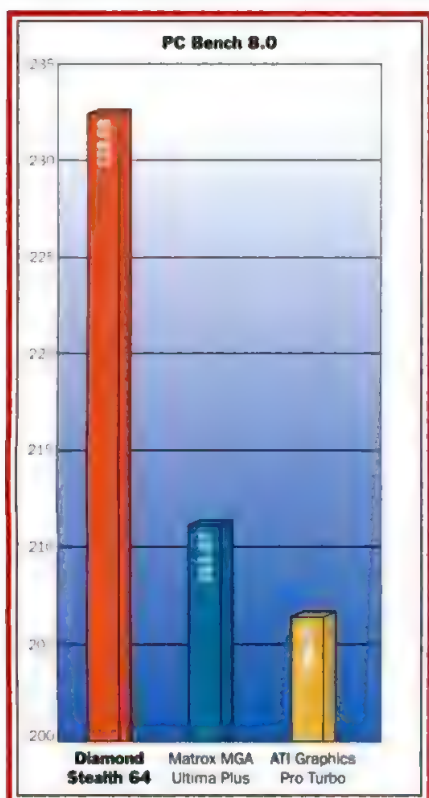
VIPeR chip (the video processor front-end to its W32x family of accelerators) have built-in DCI support. Boards based on the Vision868 and Vision968 incorporate direct support for Intel's Indeo, SuperMac's Cinepak, and Microsoft Video for Windows, and as DCI can accelerate codec handling, this built-in support speeds video playback.

Diamond is reportedly releasing a VIPeR daughtercard for its Stealth family of boards. Vendors expressing a commitment to the S3 Trio or Vision products include Diamond, ELSA, Hercules, miro, Number Nine, and STB. More vendors are expected to announce boards soon.

Finally, users of the MGA Impression will be able to access DCI hardware support by upgrading their cards with a new \$149 chip. Video-Logix's PowerPlay 64 digital video playback accelerator. The new module should be available by the time you read this. □

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Source for test results: *Computer Shopper*, September 1994, using PC Bench 8.0 on a Diamond Multimedia Stealth 64 PCI using Micron Magnum 4100 486DX4-100MHz system with DOS 6.2, 32MB RAM, and 256k cache. *InfoWorld*, July 25, 1994, VidMark 8 bit test.

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Orchid Technology

► Orchid Kelvin 64 VLB

BY JOHN R. QUAIN

Well-built and moderately priced, Orchid Technology's Kelvin 64 VLB graphics accelerator offers responsive Windows and DOS performance. Unfortunately, this graphics adapter's \$325 list price is a little higher than other DRAM-based boards. Furthermore, its awkward software installation routine and spotty performance in 24-bit color tests may encourage corporate bargain hunters to look elsewhere. The board is based on Cirrus Logic's CL-GD5434.

Although the hardware portion of the Kelvin 64's installation process is painless, the DOS software installation routine needs work. Lacking clear instructions, new users are likely to find several menu options and the lack of prompts confusing. Once installed, however, most should

find the Windows and DOS utilities fairly straightforward.

Using a Kelvin setup utility, you can set the resolution, number of colors, size of the font cache, and font size. The setup utility also lets you select a hot key for zoomed-in views or select a virtual screen option (up to 1,024-by-768 with 256 colors). A DPMS-compliant power-saving option lets you adjust power-down modes and times.

In order to select the monitor type and vertical refresh rate, you have to switch back to a DOS utility. The Kelvin supports an ergonomic refresh rate of 75 Hz in 800-by-600 and 1,024-by-768 modes with 65,536 colors. The non-interlaced vertical refresh rate drops to a less than pleasing 60 Hz in the maximum 1,280-by-1,024 mode with 256 colors.

TRUE COLORS

A solid DOS performer, the Kelvin 64 also did well in Winstone 8-bit mode. In strict 24-bit color graphics modes, though, the Kelvin 64 fell to nearly half the speed of the WinBench leaders. Those looking for a 16.7-million-color adapter should

also note that the Kelvin 64 was able to manage only a 60-Hz vertical refresh rate in 800-by-600, 24-bit mode.

In PC Labs' compatibility tests, Orchid's software drivers required more resources than most. We were able to open only four large Windows applications and two DOS windows before we ran out of memory in 800-by-600 mode with 256 colors. According to the company, the problem was due to a resource link in the software driver for the Cirrus Logic GD5434, and it expects to remedy the problem with an updated driver by the time you read this. The Kelvin 64 also had trouble playing back Indeo .AVI video files smoothly, while Cinepak .AVI files played without a hitch.

The Kelvin 64 offers a few more amenities than lower-priced offerings based on S3's Vision864. Unfortunately, it isn't able to match the price-and-performance combination offered by some of the less expensive competition.

► **Orchid Technology**, 45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300; fax, 510-490-9312.

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Mainstream Graphics Accelerators

Personal Computer Graphics Corp.

• Photon Torpedo 864 PCI

BY DON LABRIOLA

From a hardware standpoint, the \$237 Photon Torpedo 864 PCI from Personal Computer Graphics Corp. is a relatively ordinary product that holds its own against much of the competition. Despite a somewhat low price, it incorporates 2MB of DRAM and a 64-bit S3 Vision864 graphics engine to deliver 256 colors at 1,600-by-1,200 and 65,000 colors at 1,024-by-768. Our Windows performance benchmarks consistently placed it a third of the way down the list of contenders and, under DOS, it ranked about average.

Every one of the Photon Torpedo's video modes ran without lock-ups and synchronized properly with our monitors. In 600-by-480, 24-bit mode, though, the card suffered from a problem with colored ghosts that made the monitor look like its guns were misaligned. In an attempt to resolve the problem, PCG upgraded our evaluation unit's video BIOS after its evaluation had already begun, but the problem was not eliminated completely.

Another complaint we had was with the board's needlessly complicated installation and configuration procedures. The Photon Torpedo's inadequate documentation—which actually omits some important steps—will challenge all but the most experienced users.

The Photon Torpedo ships with a good selection of drivers, including support for Windows for Workgroups, Windows 3.11, OS/2 2.1, SCO Unix, and a variety of DOS CAD programs. The vendor also claims Windows NT support, although no NT drivers were found in our evaluation unit. The Photon Torpedo's utilities are limited to a primitive setup and mode-switching applet that forces you into DOS to change resolutions, color depths, and refresh rates.

The Photon Torpedo is an example of a potentially good product ruined by ill-advised corner-cutting. It's reasonably fast and competitively priced, but its installation procedures, bundled software, and documentation give the impression that it was quickly slapped together and hustled out the door. The Photon Torpe-

do could have been a contender, but with so many comparably priced and more professionally implemented products on the market, we're forced to consider it a near miss.

► **Personal Computer Graphics Corp.,** 1646 17th St., Santa Monica, CA 90404; 800-255-9893, 310-452-8470; fax, 310-392-9033.

Circle 515 on reader service card

RasterOps Corp.

• RasterOps Truevision ColorImpact 100 VLB

BY JONATHAN HILL

The VLB-based RasterOps Truevision ColorImpact 100, which lists for a mere \$219, was one of the slowest boards we reviewed, but it has a set of productivity features that puts some higher-priced cards to shame. For a user who dabbles in 24-bit



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Mainstream Graphics Accelerators

color, the board's performance should not be an issue, but at high color depths, the ColorImpact 100 performed sluggishly. The ColorImpact 100's fine pedigree can be seen in the boards' clean design, simple installation procedure, and clever utility software, but this is a product based on price, not performance.

Incorporating the 64-bit Cirrus Logic CL-5434—which combines the functionality of a VGA chip, graphics accelerator, clock synthesizer, and RAMDAC in a single chip—the ColorImpact's circuit board is remarkably clean. The CL-5434, BIOS chip, clock crystal, and DRAM make up the rest of the otherwise pristine surface.

The upgrade to the 2MB configuration that we tested is accomplished by using a standard 72-pin SIMM—a nice touch for budget-conscious users, who can purchase the 1MB version for \$139 list and upgrade easily.

Installation of the driver and utility software begins as a DOS-based program that lets you choose between Full, Express, or Custom installation. The Express option copies the DOS utilities and Windows drivers into a directory of your choice, prompts you to let it modify your AUTOEXEC.BAT, and then proceeds directly into Windows to load the ColorImpact 100 drivers.

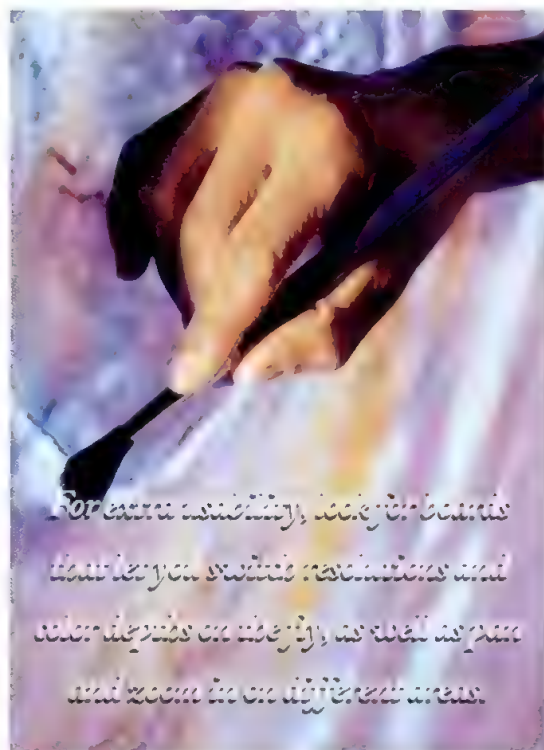
After you choose the initial resolution, the Display Checker screen pops up. If after 30 seconds you have not verified that the display looks correct, the software assumes that the screen was unreadable, and retreats to a safe (VGA) resolution to allow you to correct the problem.

The heart of the RasterOps feature set is provided by Binar Graphics' Anyview utility. Represented by a floating toolbar, the utility lets you change resolutions, but not color depth, without causing a Windows restart. Anyview also provides access to the ColorImpact Control Panel, where you can adjust the refresh rate for each resolution, and DPI Wizard, a tool for adjusting the size and aspect ratio of images on-screen.

Anyview's most interesting feature is buried in the Options pull-down in the Anyview main menu. Taking advantage of the software's ability to switch resolutions

on the fly, the Setup Association option lets you link specific applications with display resolutions. That way, you can tie Microsoft Excel to a resolution of 1,280-by-1,024 pixels, for example. Switching between the applications changes the resolution automatically, although the screen does blank out momentarily between modes. Also, when you change color depths the software checks to see if there are any unsaved changes before it closes the open applications and restarts Windows.

While its DOS Video performance was more than adequate, the ColorImpact 100 did not fare well on our WinBench and Winstone tests. In 8-bit color mode, the board was only slightly worse than the average for the boards in this



roundup, but at higher color depths performance dropped off sharply.

In 24-bit color mode at 800 by 600 pixels, the ColorImpact's scores were at the bottom of the heap. Also, the board dropped back from its stated refresh rate of 72 Hz to a nominal rate of 60 Hz in this mode.

RasterOps' initial foray into the PC marketplace ultimately falls short of expectations. But if the ColorImpact Pro 1000, a higher-performing model due out by the time you read this, maintains the features and quality of the ColorImpact

100, it could be a better match for more demanding users. *At press time, we learned the ColorImpact 100 has been withdrawn from the market.*

► **RasterOps Corp.**, 2500 Walsh Ave., Santa Clara, CA 95051; 800-729-2656, 317-577-8788; fax, 317-594-2991.

Spider Graphics Inc.

- Spider 256 Cache VLB
- Spider 64 PCI
- Spider Tarantula 64 VLB
- Spider Tarantula 64 PCI

BY DON LABRIOLA

Video-board vendors live in a cut-throat market: A \$20 price difference or a one-month shipping delay can mean the difference between a product that's profitable and one that falls by the wayside. It's not surprising, therefore, that we ran into suppliers like Spider Graphics, whose primary concern seems to be bringing its new products to market as quickly and inexpensively as possible.

If those are indeed Spider Graphics' highest priorities, then the company's current line can be judged a success: the seven boards submitted to us for evaluation were competitively priced and incorporated the latest technology from all the right chip manufacturers.

Unfortunately, the boards also appear to have been released before they were ready. Documentation was inaccurate or incomplete, utilities and drivers were flaky, and we ran into numerous hardware conflicts with PC Labs' test systems. Several of the boards, in fact, had enough problems to be dropped from the roundup with the vendor's consent.

We wound up with four products. First, there was the \$240 DRAM-based Spider 256 Cache VLB, which Spider claims is optimized for DOS applications and games. We also tested the \$364 Spider 64 PCI, which we tested with 4MB of DRAM. (The 2MB version is \$254.) Finally, we tested the VLB and PCI versions of the company's \$359 top-of-the-line Tarantula 64. The tested units had 2MB of VRAM.

The Spider 256 Cache is the most limited of the group. It provides 24-bit color only at 640-by-480 resolution. Unless

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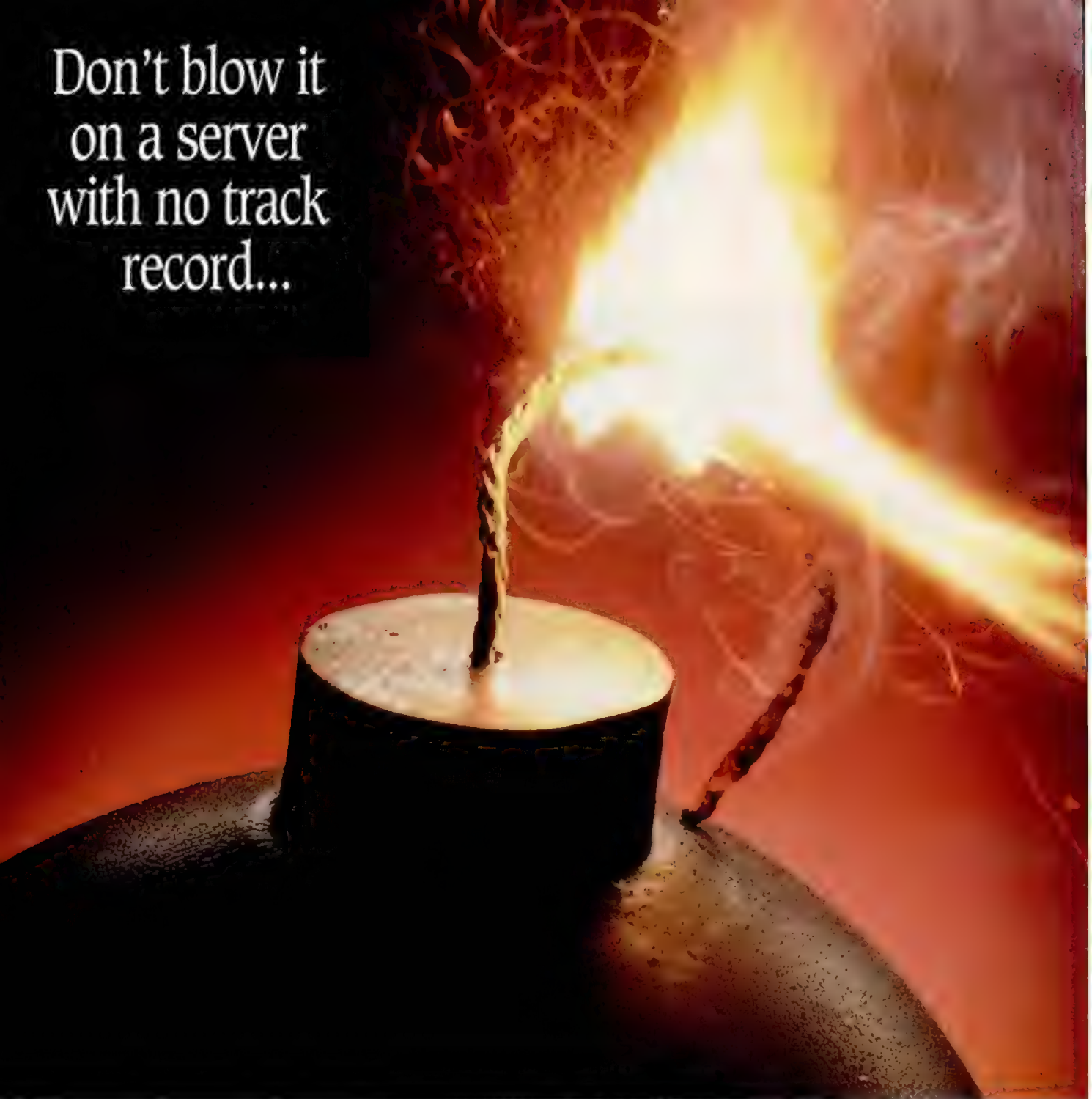
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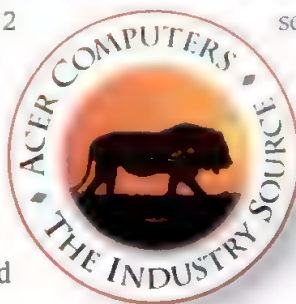
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Mainstream Graphics Accelerators

you're willing to live with flickering interlaced video, it won't deliver anything better than 256 colors at 1024-by-768 (at that resolution, it can deliver 65,000 colors only in interlaced video). In other words, it's a 2MB board that acts a lot like a 1MB product. These constraints prevented the 256 Cache from completing half our test suite, and the remaining results painted the picture of a merely average performer. Its strongest suit—its DOS performance—was surpassed by other boards in the same price range.

The 256 Cache does offer a few notable features, such as a 256K video cache and a flash ROM option that makes it easy to upgrade the board's BIOS, but these features don't compensate for the card's undistinguished performance and limited choice of video modes. The 256 Cache is certainly priced competitively, but it's only for people who are absolutely sure that they'll never need higher-resolution 24-bit color.

The Spider 64 PCI board can deliver 65,000 colors at 1280-by-1024 in the 4MB version, which we tested. The 2MB version of the Spider 64 PCI provides all the video modes you'd expect from a 2MB card, including 16 million colors at 800-by-600 and 256 at 1280-by-1024. The board also features a 64-bit memory interface.

Nonetheless, the Spider 64 was another lackluster performer, with benchmark test results that ranged from better-than-average to dismal. The board provided halfway-decent 256-color performance under Windows and didn't do too badly with DOS, but fell behind most other PCI products in 16- and 24-bit Windows modes.

Part of the problem is the board's DRAM memory and Cirrus Logic CL-GD5434 accelerator, both of which sacrifice speed for cost, but we're sure that software also plays a role. We wouldn't consider the Spider 64's bundled utilities and drivers mature enough to be included with a shipping product; in fact, we were still receiving bug-fix BIOS upgrades after our evaluation had begun. By the time you read this, the Spider 64 may have been tweaked into stability, but don't expect it to be anything more than a mid-priced, average performer.

The Tarantula 64 PCI and VLB boards, on the other hand, are Spider Graphics' superstars, providing 1600-by-

1200 non-interlaced video, an advanced S3 Vision964 accelerator, and an upgrade path to 4MB of fast on-board VRAM. Strangely enough, both cards performed poorly in our DOS tests and in the 256-color Winstone benchmark. In most other benchmark tests, though, the Tarantulas delivered impressive results, ranking near the top of their respective fields in 16- and 24-bit Windows performance.

Despite their strengths, our evaluation units suffered from the same instabilities that plagued other Spider Graphics boards. The bundled driver software let us choose video modes that the card couldn't support, the Tarantula VLB occasionally lost sync in certain 16-bit Windows modes, and both products suffered from garbled 16-color displays. Furthermore, we found that the VLB board ran slower in 16-bit mode than in 24-bit mode, an anomaly that even the vendor couldn't explain.

The Tarantulas offer excellent performance and, although they're not cheap, are priced to compete with similar VRAM products. If Spider Graphics can resolve the Tarantulas' stability problems, the boards could be strong competitors.

► **Spider Graphics Inc.**, 580 Charcot Ave., San Jose CA 95131; 408-526-0535; fax, 408-526-1622.

Circle 517 on reader service card

STB Systems Inc.

• **STB PowerGraph 64 PCI**

• **STB PowerGraph Pro PCI**

BY JONATHAN HILL

STB Systems has a winner in its new STB PowerGraph 64 PCI graphics accelerator (\$199), and the company's improved STB Vision software gives added value even to the older PowerGraph Pro PCI (\$239). Both boards provide decent performance at a reasonable price, but the newer, less expensive PowerGraph 64 has better potential in the long term.

Both STB offerings are DRAM cards that make use of 64-bit graphics accelerators from S3 Corp., but the PowerGraph 64 is particularly intriguing because it is the first shipping product to use the new S3 Trio64 integrated graphics accelerator chip. Based on the S3 Vision864 chip that drives the PowerGraph Pro, the Trio64 provides hardware acceleration for several additional graphics functions, inte-

grates a 135-MHz, 24-bit RAMDAC and programmable clock generator within the accelerator chip, and adds direct hardware support for VESA display power management signaling (DPMS) and the new VESA display data channel (DDC) specification. DDC provides a means for the monitor and graphics card to poll each other for information on resolution and refresh rate support. Full implementation requires a DDC-compliant monitor as well as operating system support, which Microsoft pledges to include in Windows 95.

REFRESHING CHANGES

Installation of the Windows drivers and the STB Vision control panel is accomplished through the use of STB's Windows-based setup program, although the refresh rate-adjustment facilities are DOS programs. (In the next release, these will be integrated into the STB Vision control.) You can adjust the refresh rate by selecting a monitor by name from a predefined list or using a standalone utility, but the standalone program, which did not work with the Trio64-based PowerGraph 64, is much more flexible.

Once installed, the STB Vision utilities provide impressive functionality. Each resolution and color depth is represented by a separate icon within the control panel, but you can also edit these selections in a dialog box you access through the Control Panel. Also, when the Virtual Desktop is enabled, you can switch resolutions on the fly. However, the Virtual Desktop is only currently supported in 8-bit (256) color mode.

The Zoom utility functions within a sizable window to magnify a portion of the screen up to 32 times. There's also the Bird's Eye utility, which lets you move around the screen by clicking on a small iconized representation of the display. The two don't really work together: When Zoom is enabled, clicking on the Bird's Eye window magnifies the image of the icon, not the portion of the screen that you're trying to select. That's because Zoom magnifies what's in the frame buffer.

PRIMITIVE PC

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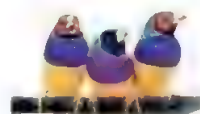
Price and performance are key factors when making business buying decisions. Perhaps that explains why Corporate 1000 companies are making the move to the ViewSonic 15G monitor. This new 15" monitor (13.9" diagonal viewable area) is an extraordinary value with features normally available only on large, expensive models.

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Mainstream Graphics Accelerators

sion864, including two-point line draws, trapezoid and polygon fills, and hardware clipping, the Trio64 did not improve the PowerGraph 64's performance relative to the older PowerGraph Pro, because the drivers for the PowerGraph 64 haven't yet been optimized to take advantage of the chip's additional functionality. The enhanced drivers, currently in development, should be out by the time you read this.

The two boards achieved nearly identical scores on all our tests, placing firmly in the middle of the range of S3-based boards on all but the 24-bit tests. By pairing its graphics accelerators with fast 45-ns DRAM, both PowerGraph boards are able to provide a stable, VESA-compliant display at all resolutions below 1,600-by-1,200. In contrast, many other DRAM-based units fail to maintain the VESA-compliant 75-Hz vertical refresh rate in 24-bit color mode. While STB's entries maintain their refresh rates at 800-by-600 in 24-bit color mode, the DRAM-based boards cannot keep up with VRAM-based products at this color depth.

All in all, the two PowerGraph boards combine good performance, interesting and useful features, and low cost to address most users' needs. At its list price of \$199, the STB PowerGraph 64 is particularly appealing, and its performance will further improve as drivers that support its enhanced functionality appear in the months to come.

► **STB Systems Inc.**, 1651 North Glenville, Richardson, TX 75081; 800-234-4334, 214-234-8750; fax, 214-234-1306.

518 on reader service card

VidTech Microsystems Inc.

• **VidTech FastMax P20 PCI**

BY DON LABRIOLA

The \$235 VidTech FastMax P20 PCI packs a lot of functionality into a relatively inexpensive package: noninterlaced 256-color at 1,600-by-1,200 resolution, the 64-bit S3 Vision864 graphics accelerator, automatic power-saving features, OS/2 and Windows NT support, and a superior offering of bundled software.

On the lab bench, the FastMax P20 turned out to be a consistent middle-of-the-road performer, producing average results on every one of our benchmark tests. We did find one bug in its video

drivers—a 1,280-by-1,024 mode that caused our monitors to dim—but overall, it was one of the most stable products in the roundup. Throughout our evaluation, the board never locked up, lost video sync, or produced any type of video artifacts.

Among its advanced features, the FastMax P20 includes support for the VESA display power management signaling (DPMS) standard. This support lets the board exchange energy-saving automatic power-down commands with DPMS-compliant monitors.

The FastMax P20's utilities let you adjust the monitor image and change resolution, color depth, and refresh rate without relaunching Windows (although you might see better video performance if you reboot Windows after each change). There's also an ambitious image-editing application that can perform a variety of Adobe Photoshop-like functions and play .FLC and .FLI animations. Called the IHU (Image Handling Utility), it is developed by VidTech.

The biggest problem we had with the FastMax P20 was its terrible documentation. The installation instructions are skimpy and fragmented, and there is virtually no reference to the card's bundled utilities and applications. As a result, the installation and configuration process is much more difficult than it has to be.

The FastMax P20 is a solid piece of hardware that offers reliable operation and good across-the-board performance. It's not a show-stopper, but it also doesn't have any major weaknesses. We did have problems with the board's poor documentation, but VidTech promises new manuals by the time you read this. Once that happens, the FastMax P20's competitive pricing, power-saving features, and bundled image editor ought to make it a good value.

► **VidTech Microsystems Inc.**, 530 Fifth Avenue NW, New Brighton, MN 55112; 800-752-8033, 612-633-6000; fax, 612-633-9164.

Circle 519 on reader service card

Western Digital Corp.

• **Western Digital Paradise Bahamas 64 PCI**

BY JOHN R. QUAIN

When looking for a graphics accelerator, "extended features," "low price," and

"top speed" are the shopper's watchwords. Unfortunately, none of these phrases apply to the \$299 Western Digital Paradise Bahamas 64 PCI. Compared with other DRAM-based adapters using the S3 Vision864 accelerator chip, the Paradise's price is relatively high, its performance undistinguished, and its features slight.

Nearly identical in hardware configuration to other PCI adapters using the same chip set, the Paradise relies on a basic DOS program to install software drivers. On our tests, installation of the Paradise was uneventful. However, the necessity of using Windows' Setup to change drivers and using a DOS utility to set vertical refresh rates seemed an unnecessary burden. No special Windows utilities are supplied, but the Paradise is capable of higher noninterlaced resolutions than many of its competitors.

The board can reach a maximum resolution of 1,600-by-1,200 with 256 colors and a 60-Hz vertical refresh. A more ergonomic refresh rate of 75-Hz is available in 1,280-by-1,024 at the same color depth, while 16.7 million colors can be displayed in 800-by-600 mode at 75-Hz, as well.

On 24-bit color WinBench tests, the Paradise was not one of the stellar performers. However, on the applications-based Winstone test, it managed respectable scores among the tightly grouped results. On other tests with lesser color requirements, the Paradise board held steady with the majority of PCI entrants and turned in results in line with other Vision864-based DRAM boards.

Generally, Western Digital puts together a fairly respectable package. The accompanying owner's manual, for example, offers all the instructions necessary for even the most inexperienced user. By this fall, Western Digital plans to release a VLB version of the card and add a zooming package and a new group of Windows utilities. As it stands, though, without additional software features and a lower price, the Paradise isn't very attractive. □

► **Western Digital Corp.**, 8105 Irvine Center Dr., Irvine, CA 92718; 800-568-9272, 714-932-4900; fax, 714-932-6498.

Circle 520 on reader service card

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First Looks

► CONFERENCING SOFTWARE

Keep Your People Talking

Tired of running off to meetings? Sit back, log on, and let the discussion begin.

By Joe Salemi

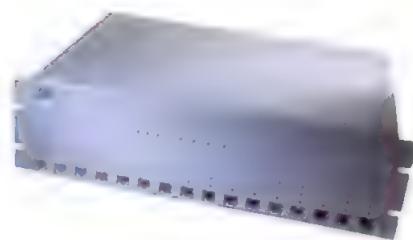
Ever try organizing a face-to-face meeting with more than two people? It's not easy to coordinate multiple schedules, make sure everyone's prepared, and maintain a meeting's focus—and do it all in a timely and effective manner. And it isn't just the meeting's organizer who has it tough; meetings tend to be disruptive to participants as well. One of the best ways to streamline an organization's operations and increase efficiency is to eliminate as many face-to-face meetings as possible and move these discussions onto the network.

LAN-based conferencing software is a step towards achieving this goal. Conferencing packages store the participants' messages and comments on-line, allowing users to create, manage, and

participate in ongoing discussions according to their own schedules. We've tested four packages that will help save precious time by eliminating the need to attend meetings physically. The group includes two new products—Collabra Share, Version 1.0, from Collabra Software, and OpenMind, Version 1.0, from Digital Communications Associates (DCA)—and new versions of two existing products—Lotus Notes, Version 3.1.5, and our previous Editors' Choice, Trax Softworks' TeamTalk, Version 1.1 (see "Let's Interface," June 14, 1994).

Conferencing software manages on-line discussions by organizing them into threads of similar topics and collecting them in forums. Various security features are provided, making the discussions available to the whole organization or to a limited number of users. The software

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100 Mbps to the desktop (NE31)

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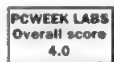
Thanks to EtherWave, you can now "daisy-chain" devices from any 10Base-T hub port or wall jack. Add a PC or printer in minutes. Connect a PC notebook without working up a sweat. Or quickly set up a small network without a hub. Finally Ethernet expansion is, literally, a snap.

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Conferencing Software

CONTINUED FROM NE1

also maintains indexes of the discussion text, speeding up searches for particular words or phrases—an important capability as the database grows.

Conferencing packages give the forum leader (called the moderator or supervisor) the ability to manage the discussions, move messages to the appropriate thread, and control user access. If you've ever used an electronic BBS, you already have a good idea how conferencing software works and what it can do for your organization.

But that's not all there is to conferencing software. It can be used as a central source for discussing, creating, and modifying organization-wide documents, manuals, and other projects. Some packages have the ability to import data (such as press releases or stock quotes) from external on-line sources into a discussion, giving the users central internal access to the information. Some even provide document management features. And many can send private messages between users, either internally or by acting as front ends to existing e-mail systems.

Collabra Share is a LAN-based application that runs on any network that supports DOS SHARE-type file locking. It gives users a complete view of the discussions, breaking them down into forums, categories, and threads. TeamTalk presents discussions in a conversation format, with each user's comments added to the end of the discussion. OpenMind is a client/server system that runs on a Windows NT server. It uses a combination of threaded and conversation formats and includes some built-in document management features. Notes' new features make groupware applications easier to create and manage. Notes also adds support for the AppleTalk protocol on OS/2, 2.1 servers; Microsoft Windows for Workgroups; and built-in support for a number of multimedia, fax, and OCR companion products. Notes 3.2 and Notes Express were scheduled to ship shortly after we completed this article. Of the four, we found Collabra Share to be the best overall product for managing on-line



• Collabra Share, Version 1.0

The conferencing software market is in a state of flux. There's no better indication of that than the replacement of our previous Editors' Choice (see "Let's Interface," June 14, 1994) by a new contender. We think Collabra Share has everything you would want in a group discussion package. It presents

discussions in a logical format, making them easy to follow and participate in. And it has excellent support for the inclusion of external objects in messages. Of the products reviewed, Share also provides the best support for creating enterprise-wide discussions, using a wide variety of e-mail links and replication services. In spite of Share's security limitations, you'll find it's the best package available for sharing ideas in your organization.

Trax Softwork's TeamTalk, Version 1.1, has the same easy-to-use and intuitive interface, excellent graphics, extensive NOS support, and external object support as Version 1.0, its predecessor (and previous Editors' Choice). Version 1.1 adds e-mail links and replication services, though its external connections aren't as extensive as Share's. It also displays messages as ongoing conversations (as opposed to a threaded format), which may make discussions difficult to follow. If you don't need extensive e-mail links or anticipate large conferences, TeamTalk can serve your conferencing needs well.

Lotus Notes is the godfather of groupware packages, and its new fea-

tures simplify creating, maintaining, and participating in group discussions. Lotus Notes, Version 3.1.5, has excellent replication services. Unfortunately, Notes doesn't provide direct e-mail connections. Non-Notes users can participate in discussions through a combination of mail gateways and application programming. Notes is much more than just a conferencing package; its extensive programming capabilities allow you to create custom applications that can fill many groupware needs. Notes would be overkill for conferencing alone, but if you already use it, you won't need anything else to create organization-wide discussions.

DCA's OpenMind, Version 1.0, takes an interesting though somewhat confusing approach to group discussions. OpenMind supports some document management features, and it is the only product reviewed that comes with a variety of external file viewers that let you examine external objects even if you don't have the application that created the object. Its current limitations, however, such as its requirement of a Windows NT server and its lack of external e-mail links, may outweigh its benefits.

conferences and awarded it our Network Edition Editors' Choice.

EXTERNAL CONNECTIONS

Conferencing software is useful even when it's limited to a single LAN, but it really comes into its own when you can extend it beyond the LAN through remote connections. External links to the conference, either through e-mail packages, replication of the conference data-

base to other LANs, or a combination of both, have become important features for creating enterprise-wide discussions.

All of the packages tested allowed us to extend discussions to remote LANs and users. Collabra Share attaches to the enterprise through its Enterprise Extension add-on. Enterprise Extension provides replication services, and it lets outside users participate in discussions

Continues on page NE6

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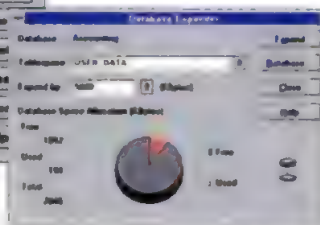
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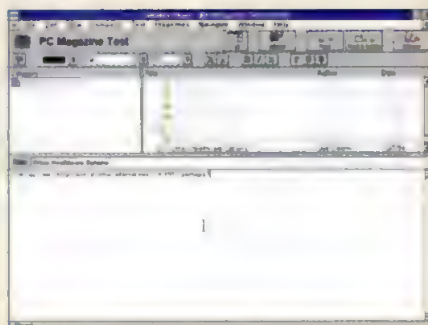
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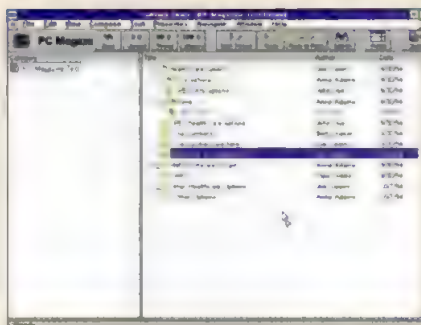
ORACLE

■ Taking a Walk Through Group Discussion Software

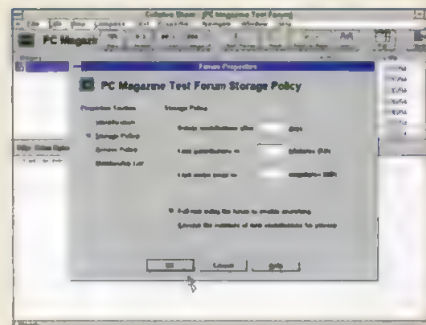
Collabra Share 1.0



CREATING DISCUSSIONS: After you click on the Start Thread button, Share switches button bars and puts you in the message window.

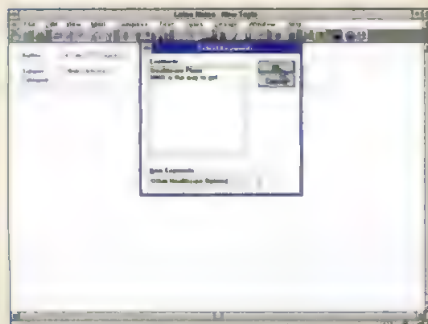


VIEWING DISCUSSIONS: Threads are viewed on the same screen. You eliminate the message window and see the entire discussion.

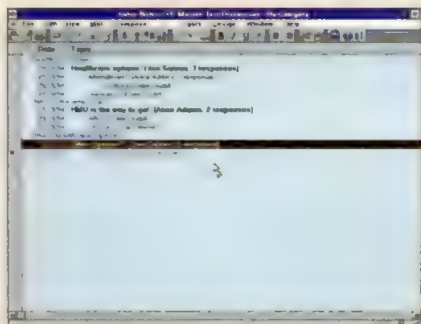


ADMINISTERING DISCUSSIONS: The moderator has complete control over the forum but can't move messages between forums.

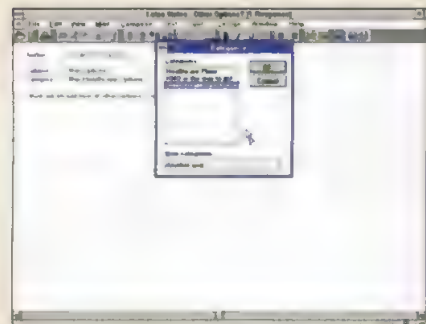
Lotus Notes 3.1.5



CREATING DISCUSSIONS: Lotus Notes organizes discussions by category. Users can add their own categories to the list.



VIEWING DISCUSSIONS: By default, users can view databases by category, author, or date. Developers can add custom views to the menu.



ADMINISTERING DISCUSSIONS: Managers can move messages to different or new categories within the discussion database.

through a wide variety of e-mail systems. TeamTalk's latest release adds replication services and allows e-mail users to participate in a discussion. OpenMind's replication services are built into the server software, but OpenMind doesn't provide e-mail users with a way to participate in discussions. Notes, the most customizable of the packages here, includes a complete e-mail system, but it doesn't support external mail links to discussions. Its strength is its replication capability. Enterprise-wide databases can be created on one server and auto-

matically replicated to other servers in the organization.

THE MARKET

Before deciding which one product is right for your organization, you have to understand how these products fit into the conferencing software marketplace. Collabra Share and TeamTalk are designed primarily as conferencing applications and fit into the low end of market. They run on most major NOSs and don't require a dedicated server or any resources other than Windows, disk

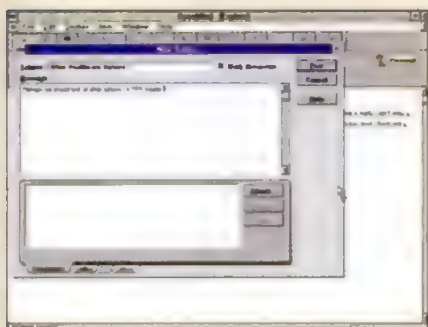
space, and a supported e-mail package that provides replication services and remote e-mail links.

OpenMind is a midlevel client/server conferencing application whose document management features position it between a conferencing application and a complete groupware package. It supports a limited number of network protocols and requires a separate server to manage the database. OpenMind has replication services, but it doesn't allow e-mail users to participate in discussions.

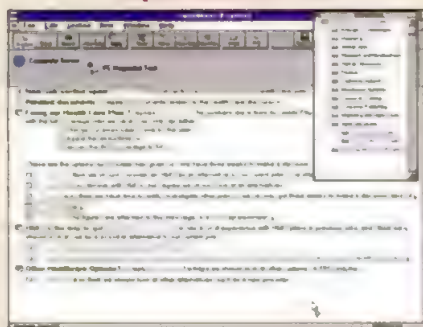
Notes is a complete groupware pack-

The four conferencing products we've reviewed basically provide the same functionality, but in very different ways. You can get a better idea of how each product works by seeing it in action. These pages show each product performing three common tasks: creating a new discussion, viewing the discussion by categories, and administering discussions.

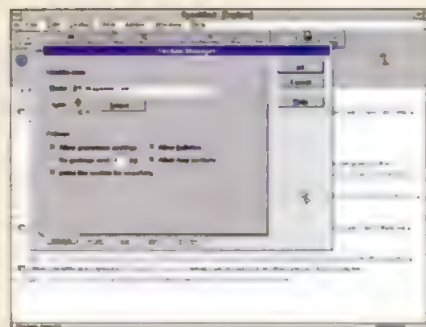
OpenMind 1.0



CREATING DISCUSSIONS: OpenMind uses a single screen that lets you attach files, send a copy as a note to several users, and other options.

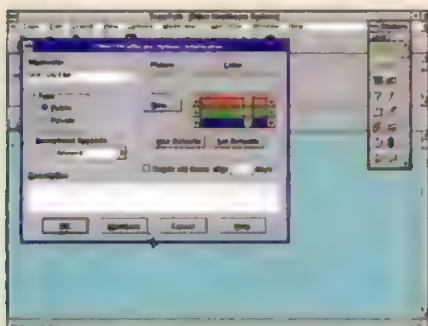


VIEWING DISCUSSIONS: OpenMind uses a hybrid of the threading and conversation formats to display a discussion.

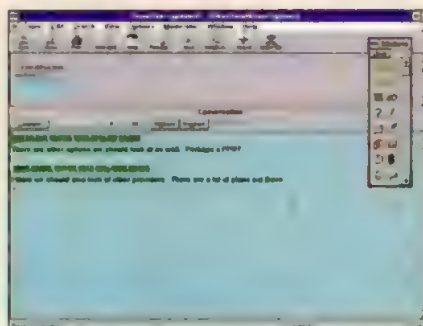


OpenMind doesn't let the moderator move messages between threads. The moderator can control only the options within a section.

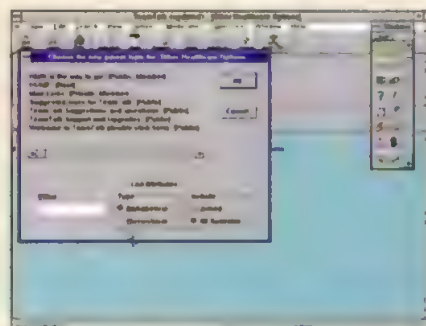
TeamTalk 1.1



CREATING A DISCUSSION: TeamTalk's simple and intuitive interface automatically makes the person who creates a new thread the moderator.



VIEWING THE DISCUSSION: TeamTalk's discussion looks like a regular conversation between users.



ADMINISTERING DISCUSSIONS: In keeping with its ease-of-use philosophy, TeamTalk lets you move only an entire thread to a different parent thread.

age that provides built-in e-mail, group databases, and workflow and conferencing features. It supports a number of server operating systems, and it is the only product of this type to support Windows, OS/2, and Macintosh workstations. It is also a complete application development environment with extensive customization and programming capabilities; you're not limited to just the database templates provided with the software. Notes' replication services make it easy to create enterprise-wide databases with excellent support for remote clients. Links to exter-

nal e-mail systems are provided via gateways, and discussions can be programmed to support e-mail participation.

MAKING A CHOICE

The first step in deciding on a conferencing package is to determine if the product supports your NOS. The low-end products work on nearly any LAN, including the popular peer-to-peer networks. Mid- and high-level packages require specific network protocols to provide communication between the clients and the server, though they do run on the major NOSs.

The next step is deciding if you just need conferencing support or if you also need other groupware features. You can choose from any of the low-end packages for conferencing support. Just pick the one that has the interface you feel most comfortable with. If you want additional groupware features, you should look at OpenMind or Notes. OpenMind's groupware features are aimed towards document management; those in Notes are aimed towards organizational databases and knowledge bases (such as technical-

Continues on page NE8

Conferencing Software

CONTINUED FROM NE7

or customer-support databases).

Decide which of these approaches best fits your needs. For example, a simple conferencing package would be fine if you're just looking for a way to support group discussions to replace face-to-face meetings. If, however, one of your organization's major tasks is creating, discussing and modifying user manuals, you'd want one of the higher-end packages. A high-end package is also better for creating a specialized application, such as a customer-support database. Next, consider if the discussions will take place only on a single LAN, or if you plan to create enterprise-wide discussions that span a number of unconnected LANs. If it's the latter, you need a package that has replication services, as all four of these products do. Replication services duplicate the discussion database on the different LANs and keep the different copies of the database synchronized.

A related factor is support for remote (dial-in) users. There are three approaches to solving this problem: E-mail links, which can also be used by local users who are not members of the discussion, such as those provided by Collabra Share and TeamTalk; remote dial-in links using the client software, supported by all four; and the remote replications supported by

Notes. E-mail users don't need the package's client software: The user can participate in discussions with existing e-mail software. This approach eliminates the cost of another client software license. It also allows your clients and customers to access discussions. The disadvantage, however, is that the e-mail user gets the discussion as individual messages, and loses the organization and flow provided by the conference application.

The remote dial-in and replication methods require a full client package. The user may also have to replicate all or part of the discussion database on a local workstation. The advantages and disadvantages are the exact opposite of the e-mail method: A remote user sees the discussion the same way local users do but must purchase an additional license for the client software. If you expect remote users to be heavy participants in one or more discussions, the remote dial-in or replication approach is better. If you only anticipate occasional remote use, the e-mail approach is the way to go.

The products tested here address the most basic to the most complex needs. They range from a standard conferencing package to a highly configurable groupware solution. No matter which you choose, you'll find that each of these packages can improve the effectiveness of group discussions.

Collabra Software Inc.

EDITORS' CHOICE **Collabra Share,** **Version 1.0**

Collabra Share, Version 1.0, just missed being included in our last roundup, but it was worth the wait. Share is very easy to set up and use, and its interface is the most

SUITABILITY TO TASK

	Collabra Share	
	Power	Ease of Use
Administration	FAIR	GOOD
User interface	EXCELLENT	EXCELLENT
External connections	EXCELLENT	GOOD

logical we've seen. It makes creating, managing, and participating in discussions simple. Add in the Enterprise Extensions and Share gains the ability to replicate and to link e-mail users to any forum (Share's discussion areas). Our only concern was the security system, which Collabra says it will address in a future release.

The Workgroup Edition (the basic package) runs on Microsoft Windows 3.1 or later and requires a 386 machine or better with 4MB of RAM. Share supports any LAN that uses DOS SHARE calls, and requires about 10MB of disk space on the server.

Continues on page NE12

Suitability To Task: **Conferencing Software**

All of these products provide basic conferencing features that let users read and respond to messages at their own pace, create new threads, and include external files as attachments or OLE objects in a message. The differentiation occurs in the additional features the software provides. We rate these four packages on how well they implement the additional features users have come to expect. Each product is evaluated for three general tasks in two categories: power, which rates the product's depth of features, and ease of use.

Administration We look at the functions involved in setting up the software, adding and maintaining

SUITABILITY TO TASK

	Product Name	
	Power	Ease of Use
Administration	POOR	FAIR
User interface	GOOD	EXCELLENT
External connections	EXCELLENT	EXCELLENT

users, and creating and managing conference sessions. We also check to see how well the product handles user and message security. The highest rating indicates that the product gives both administrators and session moderators complete control over user privileges, conference sessions, threads and messages in the conferences, and security of the users and conferences

User interface We want to see how well the product works from the user's point of view. The factors we base this rating on are primarily concerned

with how easy it is to join and participate in discussions; search for particular keywords in messages, and add external files to and extract them from messages. We also rate the products on how they organize the discussions (threaded versus chronological), and how they handle subtopics. Products that score a high rating in this task make it easy for the user to take advantage of the product's capabilities, and they should also provide additional capabilities such as user-to-user chats or private messaging between users.

External connections We evaluate the product based on three main features: how well it interfaces with external e-mail systems, how it functions remotely, and how it replicates the database between sites or servers. Products receiving the highest ratings allow for the easy creation of enterprise-wide discussions in which users can participate from either their offices or the field.

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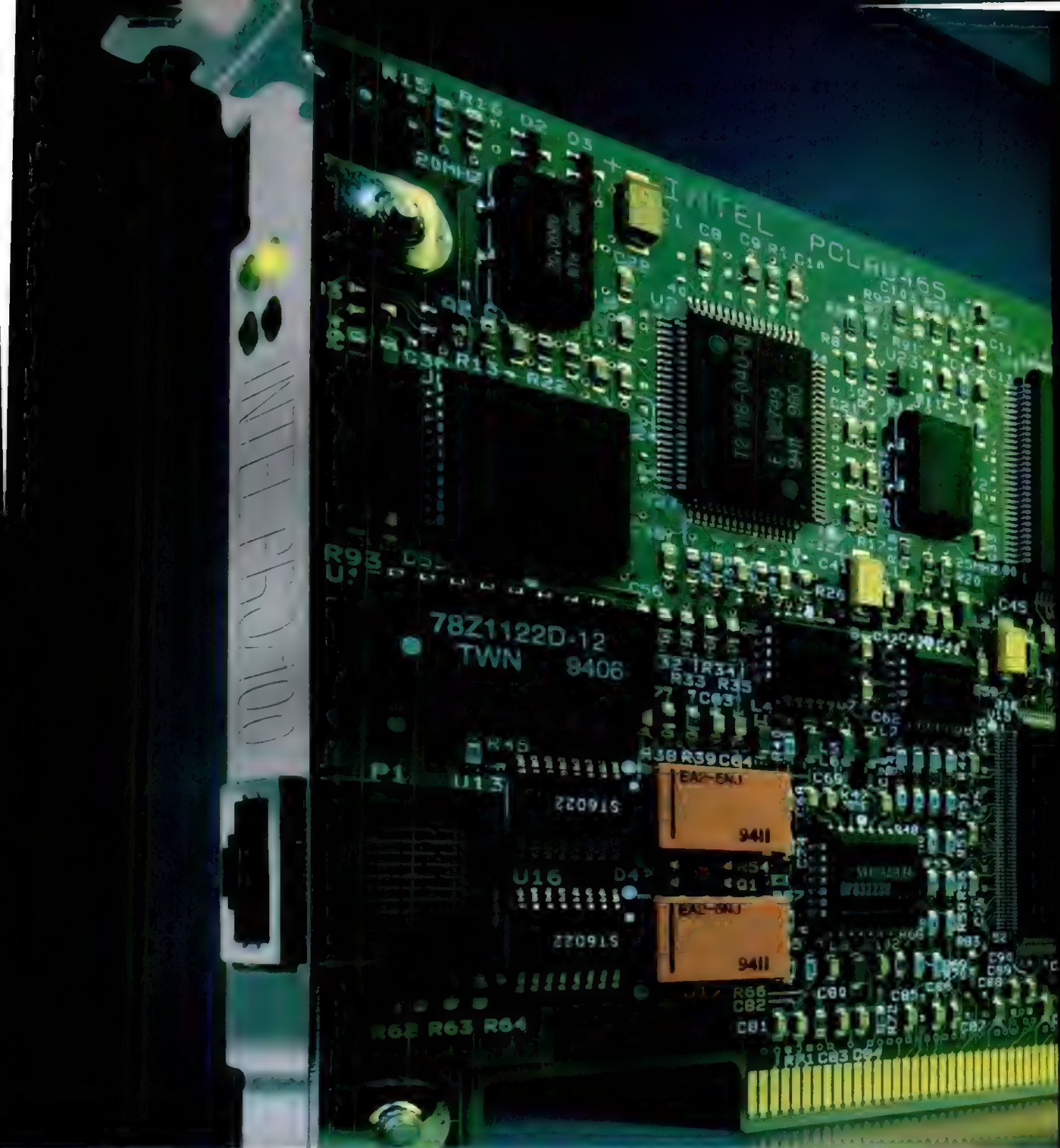
White Paper available only by mail. Information in Canada call 1-800-667-8867.



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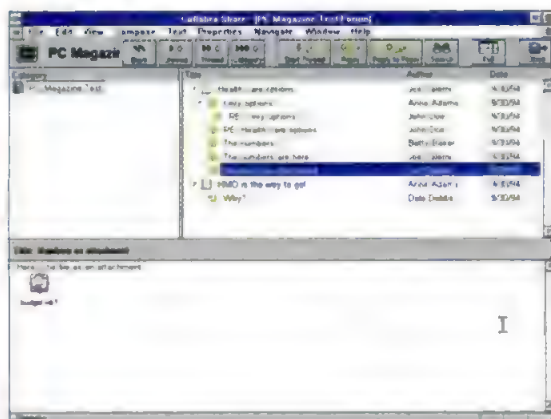
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Conferencing Software

CONTINUED FROM NE8

Share's main screen uses a notebook-like graphic for each forum. When you open a forum, the default screen splits into three panes: the topic categories, a



MULTI-FACETED: Collabra Share displays the topic category, thread headings, and text of a message.

hierarchical tree of all the subjects in the topic category, and the message body.

A forum can consist of any number of categories and subcategories, public or private. The user who creates the forum becomes the moderator. File attachments or OLE 2.0 objects can be added to messages, and searches are performed on the entire forum, which can be indexed for speed. Share also stores a large amount of information (called properties) about the forums and its users. And each user can set preferences for a forum's appearance. The moderator can also limit the size of messages or attachments, decide how long messages stay active, and specify whether e-mail users also get the attachments or OLE objects.

Share's user administration facility is its only weak point. Like Lotus Notes, Version 3.1.5, Share gives each user a separate ID file. Administration is performed through a separate utility. Unfortunately, anyone with a valid ID file and access to the utility can administer Share. The only way to prevent unauthorized users from administering the system is to limit access to the directory where the administration utility is stored.

Share is an excellent conferencing package as it is, but it really shines when you add on the Enterprise Extensions. The

Enterprise Extensions let you create e-mail links to any forum, and they support virtually every mail system in existence. Unlike TeamTalk, Version 1.1, Share doesn't limit e-mail users to a single forum. All the user has to do is create a separate mailbox for each forum and Share can move any number of messages into and out of the system. E-mail links are handled by a combination of user properties and the Share Mail Agent, which runs on a workstation and periodically checks for and distributes new messages. Replication is also handled through a supported e-mail system.

Share's support for e-mail puts it way ahead of the other low-end conferencing products, but it doesn't stop there. Share doesn't just move messages into and out of a forum. E-mail users have a full range of remote

commands that give them almost the same amount of access to the forum as

Share users. E-mail users can join or quit forums remotely, request a particular message, and create new topics by sending a mail message with the appropriate commands embedded in the subject or message body. E-mail users can also request an outline of the forum (handy for keeping the mail messages organized) and can even search the forum for text strings in messages and headers.

The only downside regarding e-mail access is for users who participate in a discussion through the LAN, but at other times through a remote mail connection. The differences in how the discussion appears in the e-mail system can cause some confusion for these users. While the outline helps somewhat, it isn't as elegant as seeing the discussion's organization in Share's user screen.

Collabra Share is the best conferencing package available today. Its intuitive interface makes it easy for users to manage it and to participate in discussions. The Enterprise Extensions extend Share's power and reach to remote users,

giving them the same access to forums as local users have. You may have to keep the security limitations in mind, but you'll find Share fits most, if not all, of your conferencing needs.

► **Collabra Share, Version 1.0.** List price: *Workgroup Edition for 10 users, \$699; Enterprise Extensions, \$899 per server.* Collabra Software Inc., 1091 N. Shoreline Blvd., Mountain View, CA 94043; 415-940-6400.

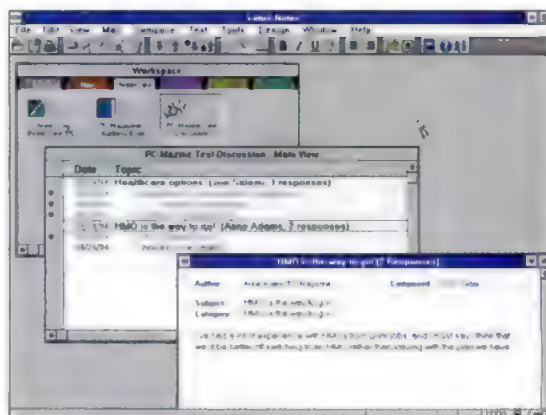
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Lotus Development Corp.

• Lotus Notes, Version 3.1.5

Lotus Notes is the definitive groupware application. In fact, Version 3.0 was awarded the Editors' Choice for best overall groupware application in our last groupware roundup ("Group Enabled," June 14, 1994). Conferencing or group discussion support, the focus of the current roundup, is but one of Notes' many features.

Version 3.1.5, the latest release at the time of this review, adds support for addi-



ON THE SIDE: Lotus Notes comes with a default discussion database form.

tional network protocols, a number of companion products, new icons in the address books, and enhancements to the workstation and server software. It also

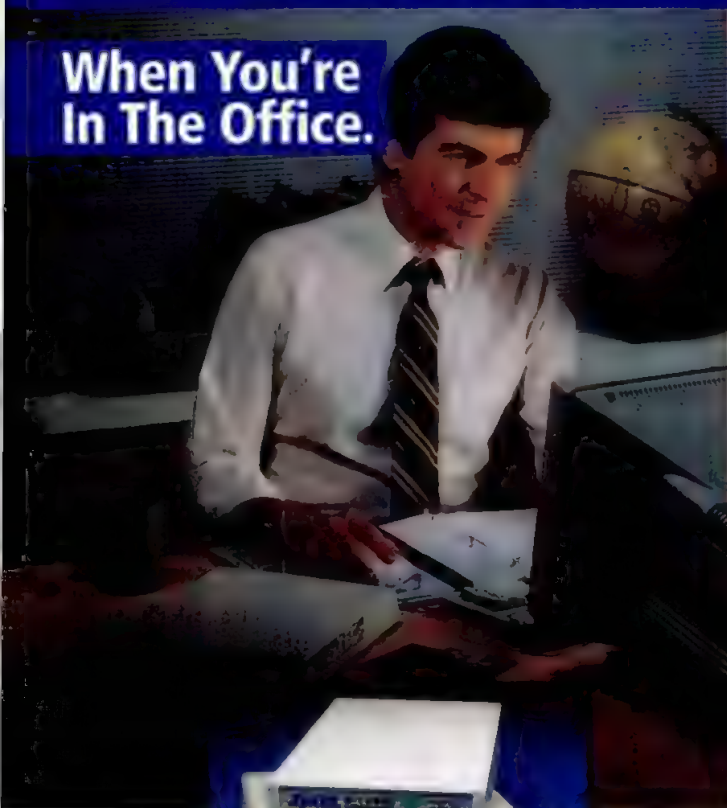
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SUITABILITY TO TASK

	Lotus Notes	
	Power	Ease of Use
Administration	GOOD	GOOD
User interface	EXCELLENT	GOOD
External connections	GOOD	GOOD

There Are Two Times When Modem Reliability Is Critical.

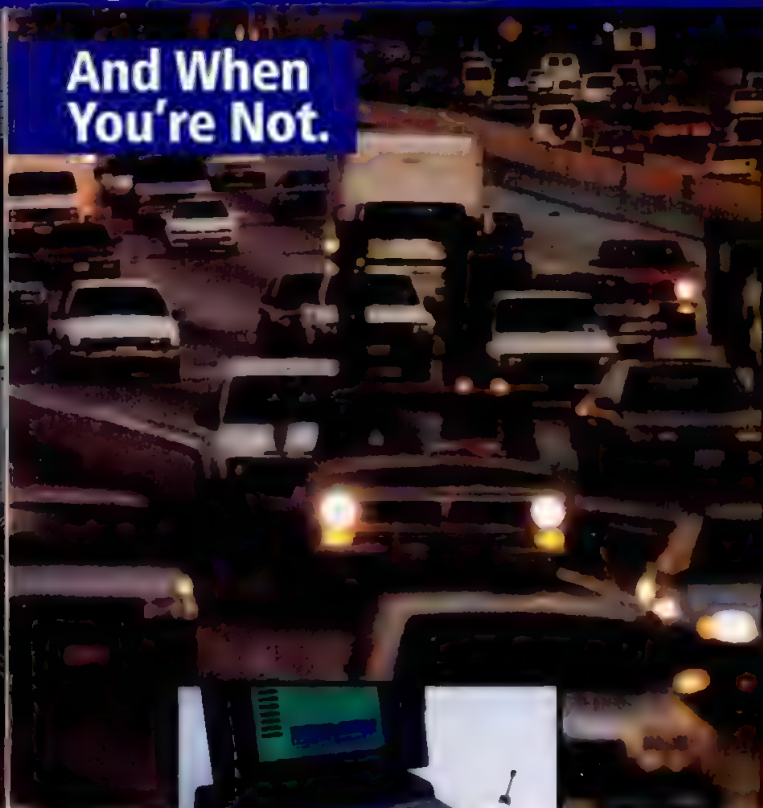
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ZyXEL land and cellular modems get through where others fail. They're specially designed to overcome poor signal conditions on the physical layer with features like fast retrain and auto fall-forward/fall-back. This means ZyXEL modems connect the first time and continue to transmit data accurately at ultra-high speeds up to 19.2Kbps* over land lines (with DTE speeds up to 76.8Kbps) and 14.4Kbps over cellular networks. Fax speed is 14.4Kbps/V.17. It's the kind of performance you only expect from high-priced modems—but with ZyXEL it doesn't cost more.

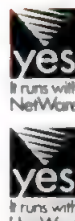
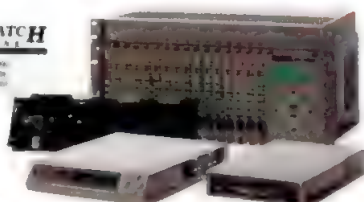
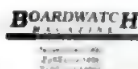
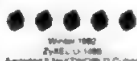
ZyXEL data/fax/voice/cellular modems have more features than other modems of any price—like digitized

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Conferencing Software

CONTINUED FROM NE12

includes a ready-made customer service application and in the best news yet, it can be installed from a CD-ROM.

Notes is a client/server application that features support for Macintosh, Microsoft Windows, and OS/2 clients. The server software is available for NetWare, OS/2, Windows, Windows NT, and Unix. Notes is also the most expensive of the four packages we reviewed: The client and server packages each cost \$495. A two-client and server starter pack is available as a \$995 bundle.

Everything in Notes is a database. You can create group discussions with the default discussion template, or you can create your own discussion format using Notes' form-design capabilities. Discussions are typically displayed in hierarchical format by topic category, message date, or author, but you can create views based on just about anything. Notes fully supports attaching files and linking or embedding OLE objects. You can even link a message in one discussion database with a message in another, reducing the need to duplicate information.

Any Notes user can create a new database; the person who creates it automatically becomes the manager of the discussion. Notes supports a number of security levels that are set in access control lists. Database users can be assigned read-only access, read-write (Author) access, or manager access.

Notes includes a complete e-mail system, but it doesn't support external mail links to discussions. The only external links available are through gateways to other mail systems, including commercial providers such as MCI Mail. The user's mailbox is just another database, which can be modified or replicated like any other Notes database.

In fact, Notes' greatest strength is its replication capability. Enterprise-wide

databases can be created on one server and automatically replicated to other servers in the organization. Remote users can dial in to the main server and automatically create local replicas of the databases. Remote users can also dial in and work with the server-based copies of the database, though this method is obviously slower than working with a local copy.

Using replication for remote support has both advantages and disadvantages. The biggest advantage is that connection

time is reduced, since only information that has been changed is passed between the remote client and the server (after the initial replication, of course). On the other hand, the remote client has the disadvantage of needing a complete copy of the client software on

the local system, which can take up an enormous amount of disk space—a bit over 32MB if you install everything (but only 10MB for the minimum installation). Active discussion databases can quickly expand to 2MB or more in size, so make sure you have a lot of free disk space if you're going to run Notes as a remote client.

Notes 3.1.5 adds support for AppleTalk networks with OS/2 servers, and TCP/IP support for Macintosh and Windows workstations. It's also certified for use with Windows for Workgroups networks. And the package supports a number of Notes companion products, including Lotus ScreenCam. ScreenCam lets you create voice-annotated recordings of Windows screen sessions, which can be used for training or demo purposes, and incoming and outgoing fax gateways. Balancing out these new features are a number of performance enhancements on the server and workstation, as well as improvements to existing script functions.

Lotus Notes would be overkill if you're looking only for a conferencing application. If, however, you want a com-

plete groupware package that provides e-mail, shared enterprise-wide databases, customizable discussions, and a robust groupware application-development environment, look no further.

► **Lotus Notes, Version 3.1.5.** List price: For 10 users, \$699. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500.

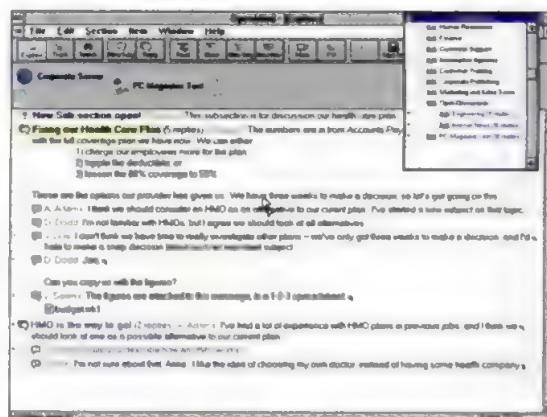
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Digital Communications Associates Inc.

• OpenMind, Version 1.0

OpenMind, Version 1.0, from Digital Communications Associates (DCA), is a client/server application that takes a unique approach to displaying and managing discussions. OpenMind uses a hybrid of the hierarchical display used by most other conferencing packages, and the conversation display used by TeamTalk. It also includes a number of built-in file viewers. Its combination of conferencing and document management features makes OpenMind ideal for organizations that have to produce extensive documentation.

Those are the benefits. The drawbacks come from the rough edges that you'd expect to find in a new release. One such limitation is poor server support: The OpenMind server runs only on a



ICONS ABOUND: OpenMind displays its icons at the top of the screen to represent topic categories.

Microsoft Windows NT server. Another drawback is its inability to connect remote users via e-mail links.

DCA refers to the product's database as the *Mind*. When installing the server,

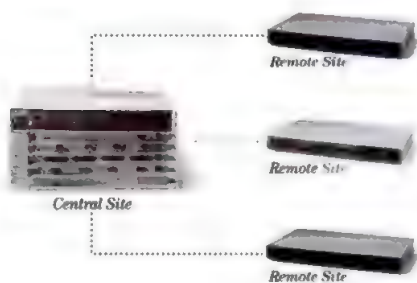
Continues on page NE16

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Conferencing Software

CONTINUED FROM NE14

you can either use the default Mind or create an empty Mind. The Mind can be set to create automatic backups as a background task, even if users are logged on.

OpenMind's primary view, the Explore view, displays the current Mind and its topics as icons at the top of the screen. Subtopics are similarly displayed. Each user also has a default area for private topics and conferences. The bulletins, messages, and file folders in a topic are displayed at the bottom of the screen. OpenMind displays the title, author, and first line of a bulletin or message, with a small arrow at the end of the line to indicate that the message continues. Responses are displayed below the original message in a hierarchical tree.

Files can be attached to messages or included as linked or embedded OLE 2.0 objects. The built-in viewers are used to display the file when you open it, and you can launch the appropriate application from the viewer menu or icon bar.

OpenMind's document management features are stored in folders, which then become part of a topic. Any user can add files to the folder and specify whether other users can make changes. OpenMind automatically tracks each version of the

SUITABILITY TO TASK

	Power	Ease of Use
Administration	EXCELLENT	GOOD
User interface	GOOD	GOOD
External connections	FAIR	GOOD

file, although it doesn't currently support searching through documents.

Other views include Track and Search. The Track view displays only marked messages or those flagged by another user. The Search view allows you to search for text in messages, bulletins, sections, or the entire database. The administrator can speed a search by choosing an option that automatically indexes the text in a discussion. OpenMind also has a navigation map that shows the sections and subsections in a tree format.

The administrator manages user IDs.

Continues on page NE18

SUMMARY OF FEATURES

Conferencing Software

Products listed in alphabetical order

■ = YES □ = NO
List price (per 10 users)

Network Operating Systems

LAN Manager
NetBIOS
NetWare
NTAS
OS/2 LAN Server
VINES
Other

Client/Server Architecture

Workstation operating systems supported:

Macintosh
OS/2
Windows
Windows NT

Server operating systems supported:

- NetWare
- OS/2
- Windows
- Windows NT

User Interface

User can view discussions by

Author _____
Category or topic _____
Date _____

E-mail connections:

OutMail
MAPI
Microsoft Mail
VIM
Other

User-to-user chats

Control object support

Attachments
DOE
OLE 2 D

Users can conduct searches by

Database
Discussion
Thread

1999

Via product interface

Administration

Security

- **Maintains user-ID information**
- Imports external-user lists
- **Supports private discussions**
- Supports anonymous messages

Discussions can be created by:

All users
Moderator only
System administrator only

Applications

Transport

General Features

Applications development language

Document generated



Collabra Share 1.0	Lotus Notes 2.1.5	OpenMind 1.0	TeamTalk 1.1
\$899	\$5,445	\$3,645	\$770
☒ ☒ ☒ ☒ ☒ ☒ Any OS that supports DOS Share	☒ ☐ ☒ ☒ ☒ ☒ TCP/IP, Windows for Workgroups	☒ ☒ ☒ ☒ ☒ ☐ TCP/IP, Windows for Workgroups	☒ ☒ ☒ ☒ ☒ ☒ Any OS that supports DOS Share
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E-mail	Proprietary	Proprietary	E-mail
☐	☐	☒	☐
C++ (with add-on), Visual Basic	Lotus Notes scripts	Visual Basic (with add-on)	☐
☐	☒	☒	☐

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Conferencing Software

CONTINUED FROM NE16

user groups, and conference sections. Section administration includes the ability to limit file sizes and set purge options to delete old messages.

OpenMind provides built-in replication services in the server software. Remote users can access the Mind by dialing directly into the server. Unlike Notes, in OpenMind remote users can't replicate databases on their local systems: The Mind can be accessed only through real-time connections. OpenMind supports sending mail messages through a MAPI- or VIM-compatible system. It doesn't provide a full front-end to the e-mail system or access to discussions through an e-mail link.

OpenMind's documentation left us confused. Information necessary for successfully setting up the system is scattered about the administrator's guide. The password for the default administrative user isn't listed. Luckily, we guessed correctly with "ADMIN." User documentation is limited to a quick reference card and the on-line help.

Document management support is fairly well implemented and easy to use. Documents are organized in folders that become part of a discussion. OpenMind also supports version control. The only major document management capability missing is the ability to search the documents for text or phrases. Unlike Notes, OpenMind does not require any programming for its document management features; they work with any windows application that supports OLE or DDE.

OpenMind is a good choice if you are looking for an application that lets your organization work on and discuss shared documents, such as user manuals, without requiring any specialized programming or customization. But OpenMind's limitations, such as its lack of e-mail support and its poor documentation, generally outweigh its strengths.

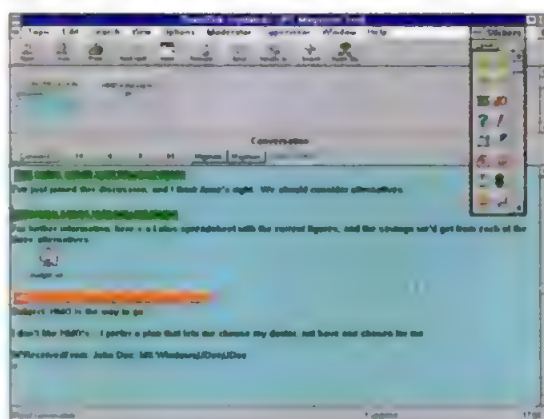
► **OpenMind, Version 1.0.** List price: For 10 users, \$2,650; \$995 per server. Digital Communications Associates, 1000 Alderman Dr., Alpharetta, GA 30202-4199; 800-348-3221.

Circle 961 on reader service card

Trax Softworks Inc.

• TeamTalk, Version 1.1

TeamTalk, from Trax Softworks, our previous Editors' Choice, is one of two packages that we are revisiting. The latest



CHAT CHAT: TeamTalk uses a conversation format for displaying messages.

release, Version 1.1, adds support for linking external users to a topic (usually called a forum) through e-mail, replicating forums on other servers, and sending

*TeamTalk, from
Trax Softworks, is the
only product reviewed
here that presents
discussions in a
conversation format.*

forum comments as mail messages. It also adds a bitmap viewer for choosing user pictures and topic icons.

TeamTalk runs on any LAN that supports DOS SHARE calls, including the majority of peer-to-peer NOSs. The client

SUITABILITY TO TASK		
	TeamTalk	
	Power	Ease of Use
Administration	EXCELLENT	GOOD
User interface	GOOD	Fair
External connections	GOOD	GOOD

software runs under Microsoft Windows 3.1. TeamTalk comes with a variety of bitmapped images, called stickers, that can be included in a message for emphasis. Users can also attach files, or embed or link OLE 2.0 objects.

TeamTalk is the only one of the four products here that presents discussions only in conversation format. The conversation format displays the messages (called comments) one after the other in a topic with a header that lists who posted the comment, instead of listing each response immediately after the message to which it is responding, as in the thread method. The conversation format is okay for small to mid-size discussions, but it can be confusing as a discussion grows. TeamTalk lets users display a hierarchical list of

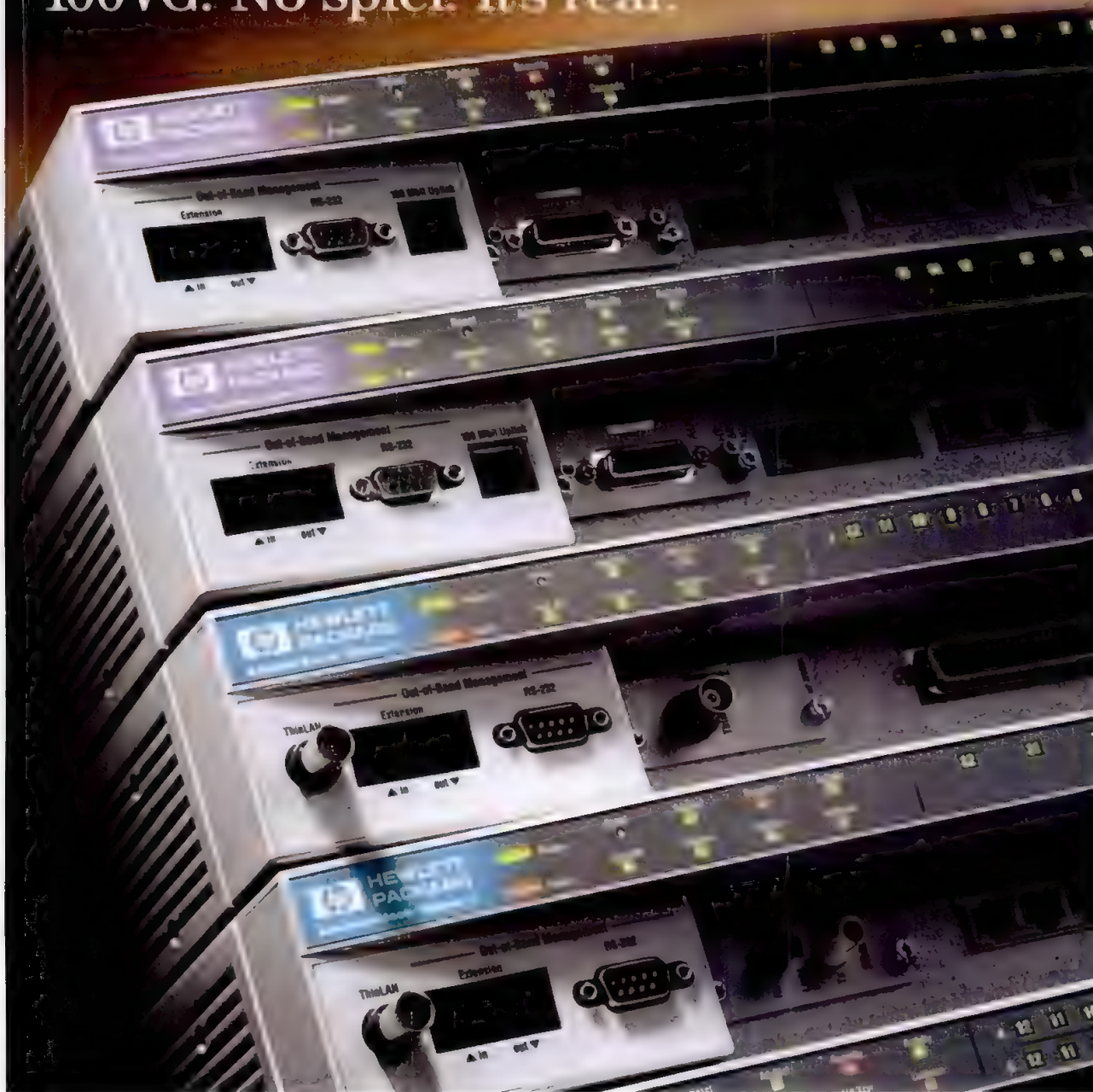
topics, but not a list of the individual comments in a topic. Users can search for words within a topic or across topics. And the software automatically maintains a word index to speed searches as new comments are added.

The first user to sign on to the system becomes the supervisor for the whole system and is responsible for creating and maintaining the system user IDs. The user who sets up a topic or subtopic becomes the moderator of the topic. The moderator determines the member list, whether a topic is public or private, and if anonymous messages are allowed. The moderator is also responsible for the administration of the topic, including moving an entire subtopic from one parent topic to another, and for setting expiration dates.

TeamTalk 1.1 adds the ability to link external users to a topic through an e-mail system such as cc:Mail, Microsoft Mail, or any MAPI- or VIM-compatible mail system. Comments can also be sent to other mail systems, such as the Internet or MHS, through the appropriate e-mail gateway. The e-mail link also provides the ability to replicate a topic to a different TeamTalk installation.

The first step in creating the link is cre-
Continues on page NE21

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CIRCLE 899 ON READER SERVICE CARD

Conferencing Software

CONTINUED FROM NE18

ating a mailbox for TeamTalk in the e-mail system. The supervisor tells TeamTalk the name, password, and mail system type, and establishes a user as the Postmaster. TeamTalk forwards new messages to the mailbox and collects new messages from it whenever the Postmaster is logged on to the system. If you want this operation to be continuous, the Postmaster must be logged on at all times.

The moderator sets up the appropriate topic members as e-mail users, so TeamTalk can forward any new comments to the user's mailbox. The supervisor or Postmaster sets up the inbound mail routing so user comments can be placed in the correct topic. Topic replication is handled by forwarding the comments to the mailbox of another TeamTalk installation. Unlike Collabra Share, TeamTalk limits e-mail members to only one topic (the one the routing is established for), limiting the usefulness of the e-mail link.

Remote (dial-in) users who need access to more than one topic can use the TeamTalk client software to access the discussion databases after dialing into the LAN through a third-party connection such as a modem server or bridge.

TeamTalk can also act as a limited front end to the user's mailbox. The user can highlight one or more comments and send them as mail messages or create a new mail message from scratch.

TeamTalk is still one of the best low-end conferencing packages available, though its limited e-mail links make it better suited for use on a single LAN where the majority of users access topics through the TeamTalk interface. If you have to support a large number of e-mail users or want to create more than one enterprise-wide discussion database, you'd be better off choosing one of the other products in this roundup.

► **TeamTalk, Version 1.1.** List price: For 10 users, \$770; upgrade from Version 1.0, free. Trax Softworks Inc., 5840 Uplander Way, Culver City, CA 90230-6620; 310-649-5800.

Circle 962 on reader service card

JOE SALEMI is a contributing editor of PC Magazine

► FAST ETHERNET

Grand Junction Ups the Ante With a Faster FastSwitch

BY PADRAIC BOYLE

Grand Junction Networks is trying to make Fast Ethernet even faster. The vendor's new FastSwitch 10/100 AG (\$8,950) offers three more 100-Mbps Fast Ethernet ports than the FastSwitch 10/100 (reviewed in "Switching to the Fast Track," October 11, 1994), including one that can optionally support full-duplex connections for a theoretical maximum throughput of 200 Mbps between the switch and server. The switch's performance is impressive and the additional Fast Ethernet ports are useful for connecting multiple servers and switches to your high-speed workgroup, but the full-duplex port failed to live up to its billing.

The FastSwitch 10/100 AG has a total of 30 ports. Most notable are the five 100BaseT ports, one of which is *dedicated*, meaning that the port provides a single, unswitched 100-Mbps connection that typically is used to connect to the server. This port can also be configured for full-duplex Fast Ethernet connections (for an additional \$400). The other four Fast Ethernet ports are *shared*, meaning that each has equal access to a single 100-Mbps segment. The basic FastSwitch 10/100 has only two 100BaseT ports—both dedicated—and can therefore only connect to two other devices via Fast Ethernet. The shared ports are best used for connecting to additional servers or for daisy-chaining

other 10/100 AGs to extend the Fast Ethernet workgroup. For example, we connected one 10/100 AG to our server, then connected another 10/100 AG to one of the shared ports to double the number of clients in our Fast Ethernet workgroup.

Clients connect to the 24 switched 10BaseT ports, each of which provides a full 10-Mbps channel between the client and server. The last port is a dedicated 10BaseT port, which is useful for connecting the 10/100 AG to other Ethernet devices or a 10-Mbps backbone.

The 10/100 AG supports only one media access control (MAC) address per

*A single FastSwitch
10/100 AG is very
well suited for
providing high
performance for up to
24 clients.*

10BaseT port (like the FastSwitch 10/100), which means that you can only connect a single node to each port. This contributes, however, to the product's very low price per port (roughly \$370). Also, the vendor maintains that the product is meant for the workgroup—not the enterprise—and therefore does not require multiple MAC-address support. After testing the product, we are inclined to agree. A single 10/100 AG is very well suited for providing high performance for up to 24 clients. With two 10/100 AGs, you can increase that number to 48—all on a single Grand Junction FastNIC 100 adapter (\$399) in the server.

Of course, you could attach even more 10/100 AGs to your original, but this could result in poor performance. While there are many possible causes for this, we feel that the most likely culprit is the

Continues on page NE22

Grand Junction Networks

CONTINUED FROM NE21

FastNIC 100, which seizes the lion's share of CPU cycles—at or near 100 percent, in fact, on our CPU Utilization test for all block sizes. By connecting multiple 10/100 AGs together, you increase the number of ports being serviced by a single FastNIC 100 (since the only server connection is to the original 10/100 AG). With CPU utilization already sky-high, we feel that connecting more than two 10/100 AGs to a single server via a single FastNIC 100 will lead to severe drops in overall network performance. Rather than connecting more 10/100 AGs to the shared ports, we suggest hooking up additional servers as needed. If you must connect multiple 10/100 AGs to a single server, we suggest that you attach each to its own FastNIC 100.

The 10/100 AG's full-duplex performance left us rather disappointed. In fact, we saw very little difference between the 10/100 AG's half- and full-duplex modes. Only when we used the largest block size (16K) on our I/O Throughput test did we see any appreciable improvement: a small jump from 63.5 Mbps for half duplex to 71.7 Mbps for full duplex.

The 10/100 AG does not come with a network management application, although Grand Junction does include an SNMP MIB with the product. Even with the MIB, however, you cannot view any statistics in real time. In addition, you must rely on out-of-band, or direct serial, connections in order to monitor port status and configure the device.

Still, the per-port cost is low and the performance is high. These factors alone make the FastSwitch 10/100 AG a powerful solution for workgroups with high bandwidth requirements.

► **FastSwitch 10/100 AG.** List price: \$8,950. Grand Junction Networks Inc., 47281 Bayside Pkwy., Fremont, CA 94538; 800-747-3278, 510-252-0726; fax, 510-252-0915.

Circle 963 on reader service card

Additional testing for this review was done by Huy Nguyen, a technical specialist with ZD Labs. Jeffrey D. Baher was the project leader.



Benchmark Tests: Fast Ethernet Switching Hub

Grand Junction Networks' FastSwitch 10/100 AG delivered impressive results throughout all stages of our tests, particularly when we used large block sizes. We saw no significant performance boost, however, when we used the FastSwitch's optional full-duplex connection to the server, rather than the half-duplex connection. Also, Grand Junction's FastNIC 100 adapter in the server demanded the CPU's full attention: It registered at or near 100 percent throughout the CPU Utilization test.—Analysis written by Padraic Boyle and Michael Ryan

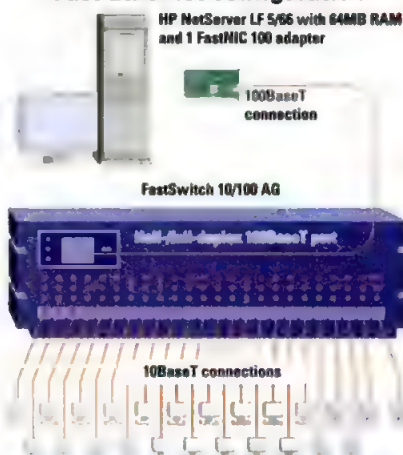
To test the FastSwitch 10/100 AG, we connected 24 clients (an even mix of 386 and 486 PCs) to the switch, which was in turn connected to a FastNIC 100 adapter in

an HP NetServer LF 5/66 server with 64MB of RAM. For comparison, we also ran the tests on a 24-client Ethernet configuration built around a Cabletron MMAC-M8FNB hub with four TPRMIM-36 modules installed. Using the same 24 clients from the first configuration, we connected 6 to each of the four TPRMIM-36 modules. These modules in turn connected to four separate Compaq NetFlex-2 adapters in the server.

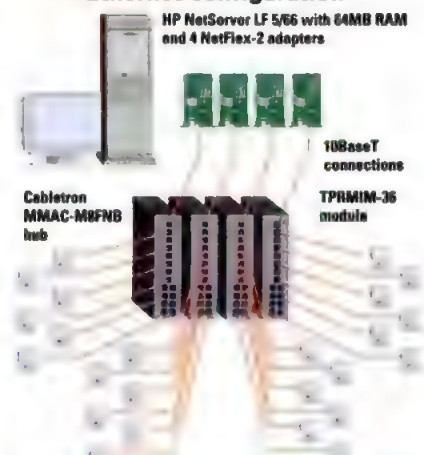
The I/O Throughput test, from NetBench 3.0, evaluates the amount of data that a client can transfer to a server and back in 1 second. A client issues read and write requests to a file stored in a server's cache. The test uses a 1MB file and blocks ranging in size from 512 bytes to 16K. We measured CPU Utilization using Novell's STAT.NLM.

Test-Bed Configurations

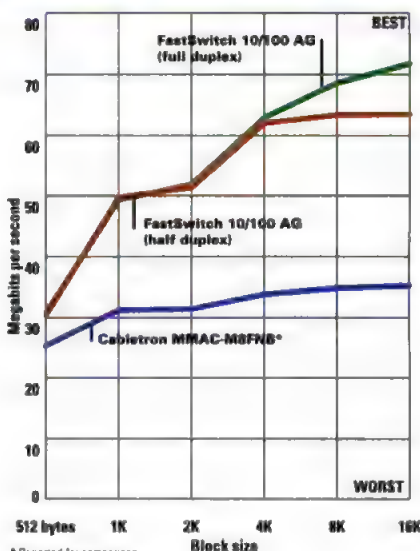
Fast Ethernet configuration



Ethernet configuration

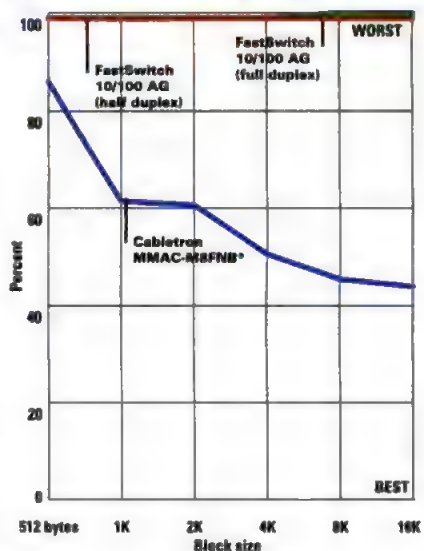


I/O THROUGHPUT

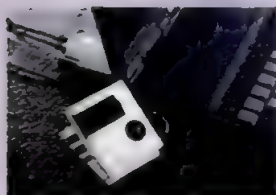


* Reported for comparison

CPU UTILIZATION



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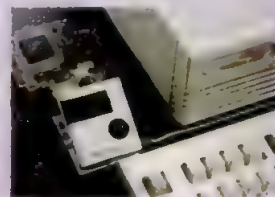
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CIRCLE 916 ON READER SERVICE CARD

► GROUPWARE

Novell Does Some Office Renovation

BY TONY POMPILI

Despite a new parent company and product name, Novell GroupWise, Version 4.1, looks and feels much like the groupware application it was as WordPerfect Office. But don't be fooled: GroupWise includes several behind-the-scenes improvements that should make life easier for network administrators.

GroupWise 4.1 is a flexible groupware package that includes e-mail, scheduling, task management, and phone messaging features for DOS, Microsoft Windows, OS/2, and Unix clients; none of that is new. This revision, however, offers an optional server architecture based on NetWare Loadable Modules (NLMs); it can reduce the hardware requirements and simplify administration. Also, GroupWise 4.1 includes several automated maintenance utilities as well as improved e-mail gateways.

The GroupWise server and client software are sold separately. On the server, the software has three components: Administration Server, Message Server, and Office Server, all of which are now available as NLMs that can run on the same NetWare 3.x or 4.x server. Previous versions required that each component run as an executable on a dedicated PC. Each GroupWise server must run the Office Server, which distributes messages to local users' mailboxes. You can, however, build an entire GroupWise network with only a single Message Server (which moves e-mail messages between Office Servers) and a single Administration Server. The latter stores configuration information for the entire GroupWise network, such as routing information for the Message Servers. OS/2 and Unix ver-

sions of the GroupWise server software are also available. Custom installation routines are provided for NetWare, OS/2 LAN Server, and VINES networks, but you can modify the routines to load GroupWise on just about any network operating system.

We loaded the three NLMs on a single NetWare 3.12 server with three client PCs. All totaled, the NLMs and client software (which we chose to run from the server) took up more than 20MB on the server's hard disk. If you prefer to load the client software on each user's PC, be warned

that the files require roughly 15MB per machine. The install routine was very easy to use, and the whole process took less than 15 minutes.

Management has never been simpler. We were impressed

with the new NetWare Bindery synchronization feature, which made it easy to add new users and track client account information. GroupWise tracks all changes to the Bindery and keeps in sync by periodically updating its own databases.

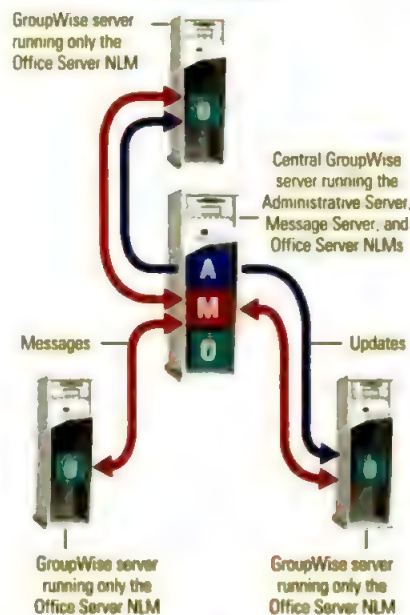
Another feature we particularly liked was OfCheck, an automated database integrity check. OfCheck is a utility that runs as part of the Office Server and searches for corrupt message files in problematic databases. OfCheck now launches automatically whenever an error is detected, unlike previous versions.

If you need to connect to other mail systems, GroupWise can accommodate you through 23 available e-mail gateways, including cc:Mail, MHS, and SMTP, as well as fax. Most of these have been modified slightly in Version 4.1 to simplify installation. We were unable to test the one new gateway, which allows users to send messages to wireless pagers, such as those supported by SkyTel.

As with the server enhancements, the changes from the WordPerfect Office

client to the GroupWise client are nearly transparent. Except for the name at the top of the screen, the interface is exactly the same: It remains very well designed and easy to use. There are a few significant new features, including MAPI support, which enables users to send and receive e-mail from within any MAPI-compliant application (such as Microsoft Word). Additionally, GroupWise now supports remote use without requiring a special remote version of the client software. Much like Lotus Notes, GroupWise allows users to select either a direct net-

Get Wise



In an enterprise-wide network, a single GroupWise server can distribute messages and updates, such as new user accounts, to the other GroupWise servers.

work connection or a dial-up session from a pull-down menu.

Overall, GroupWise, Version 4.1, offers a myriad of improvements. End users might not see them all, but network administrators are sure to notice, appreciate, and take advantage of them.

► **GroupWise, Version 4.1.** List price: Client software for five users, \$695; DOS server, \$495; NetWare server, \$2,495; OS/2 server, \$1,495. WordPerfect Novell Applications Group, 1555 N. Technology Way, Orem, Utah 84057; 800-860-2507, 801-225-5000; fax, 801-228-5077.

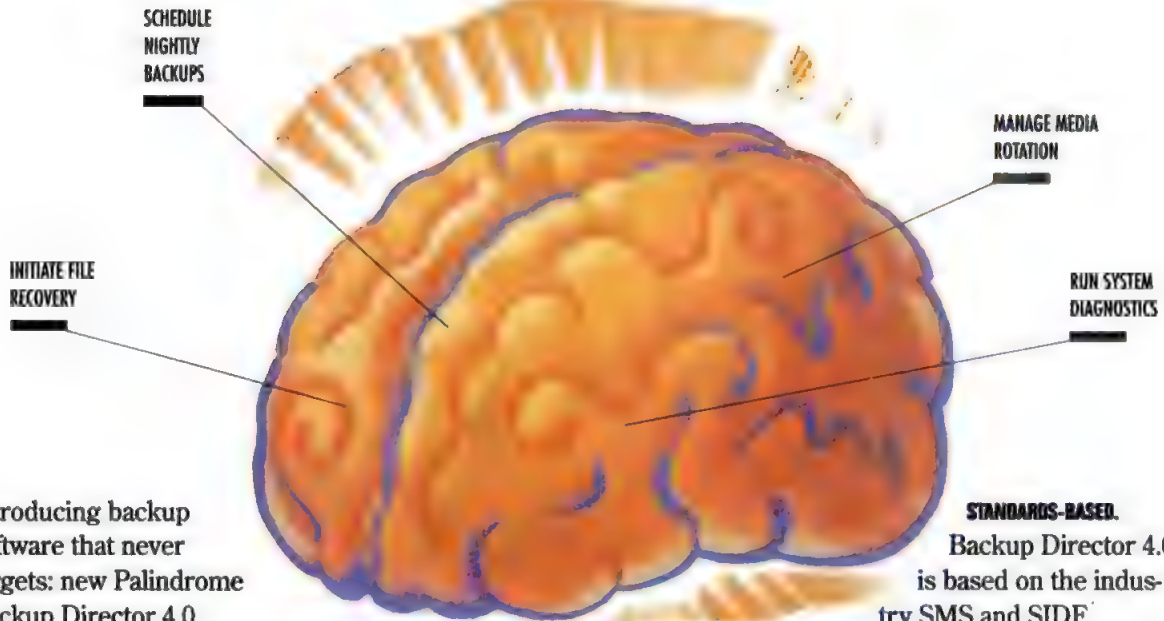
Circle 967 on reader service card



WHAT'S IN A NAME? The only visible difference between GroupWise and Office is the name.

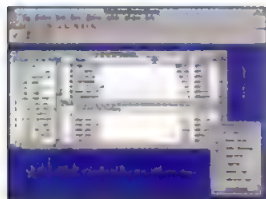
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CaLANdar Addresses the Enterprise

The screenshot displays the 'People / Resource Gantt Graph' in Primavera P3. The interface includes a top menu bar with 'File', 'Edit', 'View', 'Tools', 'Window', and 'Help'. Below the menu is a toolbar with icons for various functions. The main window is titled 'People / Resource Gantt Graph' and contains a Gantt chart. The chart shows a resource named 'Person1' (indicated by a blue bar) assigned to a task named 'Task1' (indicated by a red bar). The task duration is 14 days, starting on Friday 10/7/00 and ending on Saturday 10/14/00. The resource is assigned to the task for the entire duration. The chart is displayed in a 2D view. The bottom status bar shows the current date as '10/14/00' and the time as '11:45AM'. The status bar also includes buttons for 'Save', 'Print', 'Zoom', 'Pan', 'Reset', 'Help', and 'Exit'.

CaLANDar 3.0 is only the second major scheduling application to support enterprise-wide use. Campbell Services' OnTime Enterprise (profiled in the First Looks section of the Network Edition, October 25, 1994) also addresses the enterprise. The main difference between the two is the transport: CaLANDar 3.0

POWERLan 3.0: The Most POWERful Peer-to-Peer LAN Operating System

Modify Personal USE List for User "KAREN"

☒ Start expanded

Servers

- E
- F
- G
- H
- I
- J
- A
- B
- C
- D
- J

Personal USE

- f:\
- h:
- i:
- j:

Type: Personal USE

Server: KATNY Path:

Resource: DRIVEC

Password:

Network Drives

- f:\ drivec
- h:\ drivec
- i:\ drivec
- j:\ drivec

SCOR

Comparing
peer-to-peer
LANs



SCOREBOARD					
Comparing peer-to-peer LANs	PCWEEK LABS NEWBY	Artisoft Inc. Shimmy LANtastic 5.1	Mikcomet Corp. Windows for Work- groups 3.11	Novell Inc. Personal NetWare 1.1	Performance Technology Inc. PowerLAN 3.0 for Windows
PCWEEK LABS Overall score	3.2	3.5	3.5	4.0	

800-443-LANS

PERFORMANCE TECHNOLOGY

CIRCLE 867 ON READER SERVICE CARD



THE NEW COMSPHERE 3800Plus. IT'S A MATTER OF SURVIVAL: SURVIVAL OF THE FASTEST.

Not to be competitive here, but nobody can go faster than AT&T Paradyne. Our newest modem, the COMSPHERE 3800Plus, transmits nearly 6000 more words a minute than the next quickest modem out there. And for the record, it's the first and only V.34 modem that is capable of operating at speeds up to 33.6 Kbps. Speeds that **Access the Globe.** save you network and CPU on-line time. Making it the fastest modem in the whole wide world. As well as one of the fittest. The COMSPHERE 3800Plus modem is certainly built like a Bell Labs champion. We based it on our award-winning 3800 Series. Made it software-upgradeable over the PSTN. Added network management capabilities. And one of the most advanced security systems available.

*For access, access and more access,
call 800 482-3333, ext. 623.
We'd hurry if we were you.*



uses the e-mail system, while OnTime Enterprise uses the LAN itself. Both transports offer advantages, although CaLANDar 3.0's e-mail transport lets you send meeting notifications as mail messages to non-CaLANDar users. Meeting

able in a few of CaLANDar 3.0's screens.

Some of the less notable enhancements include a cartoonlike, "balloon" help system. This feature, which pops up a help balloon whenever the mouse pointer hovers for a few seconds over a

code (the product ships in a demo mode). This was only a minor inconvenience, but we feel it wouldn't be too difficult for the vendor to activate the software before shipping it—especially considering that the bulk of CaLANDar licenses are sold



notification via e-mail is especially helpful to users who want to leave their e-mail applications—but not CaLANDar—running all day. OnTime Enterprise users, on the other hand, must launch the application to view calendar updates.

Other vendors, including CE Software and Microsoft Corp., have also announced plans to incorporate enterprise-wide features in future releases of their applications (Network Scheduler and Schedule Plus, respectively).

Also, CaLANDar 3.0 adds limited drag-and-drop controls. For example, you can create and modify appointments with a few simple mouse clicks. Unfortunately, the drag-and-drop controls are only avail-

TOUCH OF A BUTTON: The button bar provides easy access to CaLANDar's features.

button or section of the screen, is great for new users. Once you get used to the interface, however, you'll want to turn it off; it can become irritating.

Installation was fairly straightforward during our evaluation. CaLANDar 3.0 reads user names out of your e-mail system's database, which greatly simplifies setup. Setting up the e-mail gateway required a multitude of steps, but the documentation detailed the procedure very clearly. One thing we didn't like was the product's license scheme, which requires you to call the vendor for an activation

through direct sales.

Carryover features in CaLANDar 3.0 include support for DOS, Windows, and Macintosh clients. Also, CaLANDar 3.0's graphical interface is still one of the more intuitive on the market.

CaLANDar 3.0 will appeal to those interested in MAPI, VIM, and STD mail systems. While the few other enhancements are useful, they alone will probably not win over any new customers.

► **CaLANDar, Version 3.0.** List price: For 5 users, \$595; for 50 users, \$1,995. Microsystems Software Inc., 600 Worcester Rd., Framingham, MA 01701; 508-879-9000; fax, 508-626-8515.

Circle 964 on reader service card

CHAMELEON 4.0

TCP/IP Applications for Windows

Includes WinSock TCP/IP

100% DLL

Only 6KB Base Memory

5 Minute Install

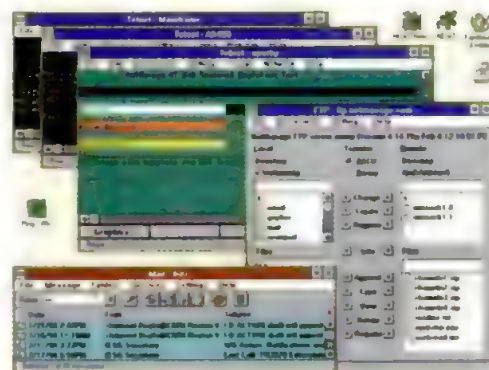
**Internet Communications:
Office, Home,
Remote**

24 WINDOWS APPLICATIONS, MORE THAN ANY OTHER TCP/IP PACKAGE.

APPLICATIONS Telnet (VT100, VT220, TVI), TN3270, TN5250, FTP (client & server), NFS (client & server), SMTP Mail with MIME, NewsReader, PROFS Mail, LPR/LPD, Gopher, Phonetag, Ping, Finger, BIND, Whois, Scripting, Statistics, Custom, TFTP, SNMP Agent, and more.

TERMINAL EMULATION Advanced features include scalable fonts, scripting, button pad, screen capture, drag-and-drop keyboard remapping and printing. **INTERNET ACCESS** Easy point-and-click access to the resources of the Internet.

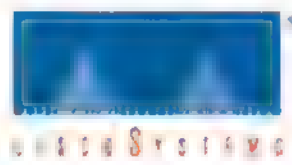
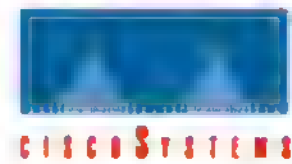
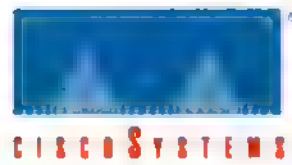
Read and post to news groups, download software or documents and search gopher space. **NFS** First ever client and server for Windows provides transparent file and printer sharing (ask for Chameleon/NFS). **MAIL** Internet SMTP Mail with folders, rules and MIME multi-media attachments. **DEVELOPER TOOLS** Windows Sockets API; ONC RPC/XDR; WinSNMP, FTP, SMTP APIs, Visual Basic support and more.



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Here's A List Of All The Companies That Can Solve All Of Your Low-End Internetworking Problems.



As you can see, no other company gives you more low-end internetworking solutions. With Access by Cisco,[™] we've expanded our access product line to meet your low-end internetworking demands. From software-only routers to PC cards to enterprise remote servers. And as part of our completely scalable product line, Access by Cisco gives you a low-end platform that expands according to your internetworking needs. Also, our exclusive Internetwork Operating System[™] ensures that your network can talk to any other network regardless of protocol, medium, or platform. If you're considering a low-end router, why not get an expert opinion? Call us at 1-800-859-2726. You'll see there is only one answer.

Access by Cisco.[™] Bringing the power of internetworking to everyone.[™]

THINGS TO DO!

INSTALLATION & CONFIGURATION:

- ① LOAD BACKUP DISKETTES AND ANSWER LOTS OF QUESTIONS.
- ② DEFINE AUTOLOADER PARAMETERS AND INTEGRATE WITH BACKUP SYSTEM.
- ③ CREATE BACKUP SCHEDULE -- WHAT FILES, WHEN, HOW OFTEN
- ④ DEFINE BACKUP RETENTION SCHEME.
- ⑤ CALCULATE NUMBER OF TAPES REQ'D
- ⑥ FINALIZE TAPE NAMING SCHEME.
- ⑦ DETERMINE TAPE ROTATION SCHEDULE.

DAILY OPERATION:

- ① MAKE SURE CORRECT TAPES ARE IN AUTOLOADER.
- ② CHECK WHICH TAPES SHOULD BE REPLACED.
- ③ MAKE SURE THERE'S ROOM FOR MORE DATA ON EXISTING TAPES.
- ④ CHECK ERROR LOG AND RESOLVE ANY PROBLEMS.
- ⑤ DETERMINE CLEANING SCHEDULE.
- ⑥ IF HEADS NEED CLEANING - SEE PG 2 - STEPS #1-20 FOR DETAILS.
- ⑦ RESTORE FILES FOR USERS (IF TIME PERMITS.)

THINGS TO DO!

INSTALLATION & CONFIGURATION:

- ① LOAD STACCATO DISKETTES AND HIT "ENTER."

DAILY OPERATION -

- ① IGNORE FOR WEEKS OR MONTHS WHILE YOU DO YOUR OTHER WORK.

Legato Staccato. Because You Already Have Plenty To Do.

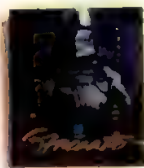
As network manager, you have plenty of work to do. Other "automated" backup solutions promise to eliminate time-consuming chores, but most aren't really very automated.

Legato's Staccato™ automated backup software is the answer. Along with Hewlett Packard's new low-cost SureStore 12000e Tape DDS Digital Audio Tape (DAT) technology autoloader. This winning combination delivers true zero-intervention NetWare backup. Set it up once and forget about it for months at a time. And since the autoloader and software solution is under \$5,000, automation is now affordable for even the smallest LAN, remote offices, and workgroups.

Staccato offers affordable, easy-to-install backup for DOS, Macintosh®, OS/2, and Unix® data residing on a single NetWare server. Tape labeling, handling, rotation, and cleaning are completely automated for weeks or months at a time. No LAN experts required. It even alerts you if any action needs to be taken. By e-mail, if you want.

Staccato's Microsoft Windows®-based interface makes file recovery a simple point-and-click away. And since Staccato is the first totally automated backup solution for LABS (Low Admin Backup for Servers) that is hardware independent, it will run with virtually any autoloader you may buy in the future. You can also leverage your investment by upgrading to Legato's NetWorker™. And use the same tapes to protect multiple servers and desktops.

For a free white paper on low-administration backup, call 415-812-6000, ext. 303.



Staccato
Legato's Automated
Backup Solution



LEGATO™

**Network
Edition**

NEW & IMPROVED

News of announced network products and upgrades

By Vicki B. Jacobson

IMPROVED

Symantec Expands Client Coverage

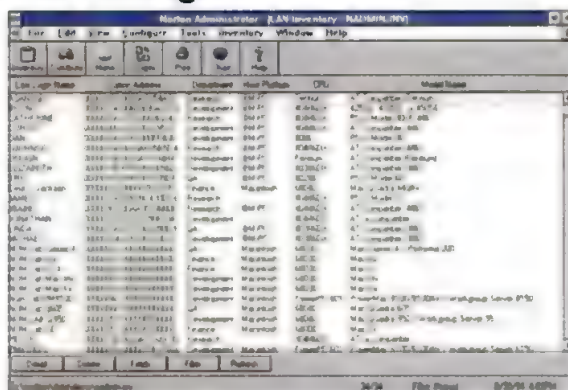
Symantec Corp. expands the client support in Version 1.5 of The Norton Administrator for Networks network management software to include Macintosh and OS/2 workstations. Depending on the platform, The Norton Administrator provides automated hardware and software inventory, software distribution, and PC-license metering.

Hardware and software inventory is supported on four major platforms: DOS, Macintosh, Microsoft Windows, and OS/2. The expansive hardware-inventory feature for PCs includes BIOS information and the type of memory. Just as impressive is the PC software-inventory feature, which searches for over 1,500 applications. The Macintosh software inventory checks for desk accessories and font control panels as well. Software distribution is supported on the DOS, Windows, and Macintosh platforms; license metering exists only for DOS and Windows.

From a central console within the software, the network manager can also administer other Norton utilities for such tasks as virus protection, password security, and file-system recovery and repair.

► **The Norton Administrator for Networks, Version 1.5.** List price: For 5-user license, \$325. Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014-2132; 800-441-7234, 408-252-3570.

Circle 952 on reader service card



CLEANING HOUSE: The Norton Administrator features immense hardware and software inventory support.

NEW

ZDS Quadruples Server Power

With its support for up to four 90-MHz Pentium CPUs, Zenith Data Systems' ZDS Z-Server GT series blazes into the high-end server market. Based on Intel's specification for multiprocessing (Multiprocessing Specification, Version 1.1), the servers can support multiprocessing operating systems such as Microsoft Windows NT and SCO MP. The Z-Server GT units can be configured or upgraded for one, two, three, or four Pentiums.

The server's design integrates the EISA, PCI, and SCSI buses. It can also accommodate up to 1GB of RAM and up to 24GB of storage. Other features include ECC memory, hot-plug disk drives, and RAID 1 and 5 support for fault tolerance.

► **ZDS Z-Server GT series.** List price: \$14,000 and up. Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-533-0331, 708-808-5000; fax, 708-808-4434.

Circle 953 on reader service card

HOT PROSPECT

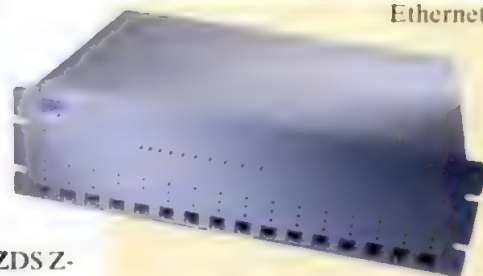
Bulk for Your Backbone

Grand Junction Networks brings 100-megabit-per-second (Mbps) throughput to a network—from the backbone down to the desktop. The FastHub 100 is a 100BaseT repeater that provides 100 Mbps to workgroups, centralized servers, and switch-based networks.

The FastHub addresses the needs of users who require additional bandwidth for applications such as CAD, CAE, color publishing, and software development. By daisy-chaining two FastHubs, you can connect up to 30 users, each with a separate 100-Mbps connection. Or, in a network designed for server-to-server communication, you can interconnect up to 30 servers.

For a massive switch-based environment, network managers can link the two FastHubs to up to 30 FastSwitch 10/100 Fast

Ethernet



switches. This combination supports up to 750 switched Ethernet users and up to 30 Fast Ethernet servers.

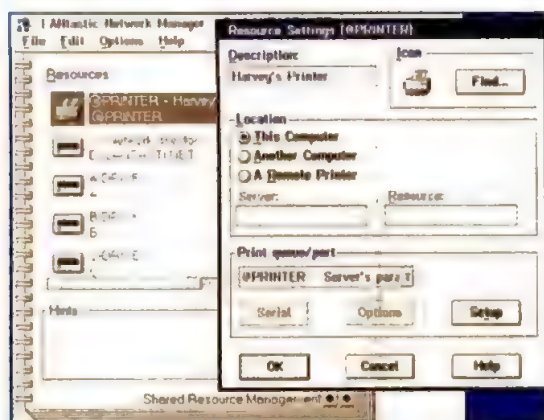
► **FastHub 100.** List price: \$3,995. Grand Junction Networks Inc., 47281 Bayside Pkwy., Fremont, CA 94538; 800-747-3278, 510-252-0726; fax, 510-252-0915.

Circle 951 on reader service card

NEW

LANtastic Gains OS/2 Support

Now OS/2 users can move to a peer-to-peer NOS while still maintaining a 32-bit multitasking environment—with Artisoft's LANtastic for OS/2. With this added support, OS/2 machines can coexist on the same network as Windows and DOS clients. Users



OS/2 TOO: Artisoft brings the first peer-to-peer NOS to OS/2 users with LANtastic for OS/2.

can also load additional client software such as NetWare 3.x and 4.x and IBM's OS/2 LAN Server, allowing them to run on multiple networks simultaneously. The software is compatible with Artisoft's other NOSs, as well as Microsoft's Windows for Workgroups, Windows NT, and LAN Manager.

Artisoft preserves the look and feel of OS/2 by using the native OS/2 Presentation Manager GUI for installation and use. Programs within Presentation Manager let the network administrator control client and

server performance through drive and print redirections, account and resource management, and audit control. Users can take advantage of OS/2 printer queues for rushing, holding, deleting, and viewing the status of a job.

Network managers can take advantage of a variety of security features, including Access Control List, which specifies account privileges and access rights for the individual or group.

► **LANtastic for OS/2.** List price: \$139. Artisoft Inc., 2202 N. Forbes Blvd., Tucson, AZ 85745; 800-233-5564, 602-670-7100; fax, 602-670-7101.

Circle 954 on reader service card

NEW

AmberSwitch: High Performance, Low Cost

Amber Wave Systems announced an 8-port LAN switch for under \$2,000 (\$250 per port). At a fourth of the price of competing products, the AmberSwitch can be configured with up to 32 ports for as little as \$175 per port. The AmberSwitch is designed for 10BaseT Ethernet networks with plans to move to Fast Ethernet by the second quarter of 1995. It supports more than 4,000 active network addresses and sustained throughput of over 600 megabits per second. To ensure network reliability, the switch supports redundancy through the Spanning Tree protocol and packet error checking. An SNMP agent provides management support.

► **AmberSwitch.** List price: \$1,995. Amber Wave Systems, 403 Massachusetts Ave., #202, Acton, MA 01720; 508-266-2852; fax, 508-266-1159.

Circle 955 on reader service card



PRICE(D)LESS: Amber Wave brings the cost of LAN switching down to as little as \$175 per port.

BRIEFS

NETWORK MANAGEMENT

Hughes LAN Systems announced a new management service for the care of large LANs. LAN CARE is a suite of services for installing, evaluating, modeling, and troubleshooting your network environment. The service package (\$9,500) includes installation of remote data-collection equipment and consultations for evaluating the collected data. LAN CARE is based on RMON-based LanProbes from Hewlett-Packard Co. 415-966-7300.

Digital Equipment Corp. and Frontier Software together will provide a new feature targeted at enhanced performance monitoring for their existing products. They plan to add Frontier's RMON agent to a multiport Ethernet agent module for the DEChub 900 MultiSwitch. This will enable monitoring of the multiple LAN segments on the DEChub. 508-486-5198.

Advanced Computer Communications' RiverView for Windows is the company's new Windows-based SNMP network management application for its line of bridge/routers. RiverView (\$1,895) allows network managers to configure the products remotely, and monitor data flow and system performance. With its autodiscovery feature, the package can identify devices and create hierarchical maps of the network. By clicking on a router icon, you can have RiverView display a bit-mapped image of the physical layout of the device. 408-366-9600.

J&L Information Systems also announced an SNMP-based management package: ChatView for SNMP. ChatView (\$1,995) includes real-time monitoring of the company's ChatterBox processors, logging of network activity on the processors, and the ability to issue remote hardware resets. 818-709-1778.

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Windows NT architecture seamlessly integrates more than 1,000 business solutions, including the ones you use now.

easier. And it provides complete connectivity with your existing networks, including NetWare®, UNIX®, Macintosh® and IBM® SNA systems, so your current network can take advantage of the new generation of server applications coming to market on Windows NT. Quickly and easily.

Introducing the new Microsoft family of server applications.

Now more than ever, efficient information sharing and management is crucial to serving customers and staying competitive. The new Microsoft family of server applications—for

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The new 3.5 release of Windows NT Workstation has a substantially smaller memory requirement and runs applications up to three times faster—with full integration (via OLE objects) and crash protection for both 16- and 32-bit applications. It continues to be the best choice for a secure desktop, ensuring all important files and programs are protected from tampering and user error.

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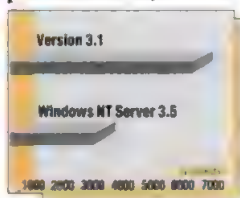


Microsoft

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Leading companies run their business on Windows NT. "Windows NT is the ideal platform for Tullett & Tokyo to implement our advanced real-time derivatives system."
—Len Monteleone, V.P. of I.T.



*New Windows NT Server 3.5 runs your applications twice as fast.***

database management, messaging, host access and system management—can seamlessly integrate corporate information with the desktop to radically improve business performance, whether you're an emerging company or already one of the Fortune 500. And the open Windows NT Server platform integrates solutions from other major vendors in the industry as well, giving you maximum choice.



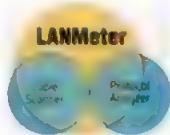
Fast help for trouble on the road.



Fast help for trouble on the information superhighway.

Fluke LANMeters™: faster answers to more of your network problems. Traffic snarls, bad hubs, and duplicate addresses can bring your LAN to a standstill. But help is at hand. In seconds, the Fluke LANMeter isolates these problems, plus mis-configured routers, cable malfunctions, failed NICs, and more.

The LANMeter gets you out of all kinds of jams on Ethernet or Token Ring networks. Use it for real-time analysis of network errors, collisions or traffic statistics. Or spot



Fluke's LANMeter combines the best functions of traditional tools with unique new capabilities to solve more network problems than any other single tool.

trouble ahead by using the LANMeter proactively for installations, benchmarking tune-ups, and network audits.

Nothing is easier to use than a LANMeter. You can learn how in 30 minutes or less. Answers appear at the push of a button without complex programming or wading through screens of decodes. And its compact size makes the LANMeter easy to use under a desk or in a wiring closet. All reasons why the LANMeter has won an armful of awards and was named "The Best of Times" by *LAN Times*.

Test drive the new LANMeters from Fluke, the leader in reliable, handheld test and measurement tools.

Call 800-44-FLUKE today for a step-by-step demo you can run on your PC.

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Tools for Healthier LANs

FLUKE.

The Network Show Guide

I'm showed out. It was bad enough when there were two NetWorlds a year. This year there was the NetWorld+Interop flea market in Vegas, followed by yet another NetWorld+Interop bonanza in Atlanta, plus three Networks Expos in Boston, Dallas, and San Francisco. And that doesn't even include the two ComNets, the Comdexes, or the PC Expos that are spread across the calendar.

With so many shows to choose from, which should you go to? I guess the good folks at Ziff would love you to visit just NetWorld+Interop (They own the show and, of course, publish *PC Magazine*). But I wouldn't ignore the other shows so fast. True, the Dallas Networks Expo was smaller than the past few Dallas NetWorlds but it was still sizable. Indeed it would have filled the Infomart, the original home for NetWorld; and while we jaded members of the press talked about its shrinking size, the "ordinary" people for whom these shows are presumably designed filled the booths and were heard wondering how they could possibly attend all the seminars they wanted to, and also have time for the exhibits.

If, however, one ranks shows by exhibitors, and has any doubt about Novell's role in our industry, this year proved just how important the NetWorld name has become. The Las Vegas and Atlanta shows had far more vendors than the Networks Expo shows.

Does that mean that if you can go to only one conference a year, it should be a NetWorld+Interop? Not necessarily. Smaller regional shows can actually be better; generally the quality of the seminars is the same. Quality depends on good speakers, and there are enough knowledgeable people in our industry to fill the seminar slots of all the shows.

Education, however, seems less important today as a reason for going to a show. Attendance at the seminars has been falling for a couple of years: Sessions that used to draw 500 or 1,000 people now draw 50 or 100. This is true even if one makes allowances for topic choices. The hot topics of today draw far fewer attendees than the hot topics of yesteryear.

As a frequent speaker at these conferences, I admit that the attendance decline had both frustrated and baffled me until I started thinking about why people go to seminars. They are looking for information they can't get elsewhere, at a reasonable price and for a reasonable investment of time.

When I installed my first NetWare



By Diane
Danielle

LAN, the only source for education was the Dallas NetWorld. (There was one book on networking and one on NetWare and both were out of date. There were no network magazines.) Today, the bookstores are overflowing with books and there are more than a dozen publications that focus solely on networking. Most of the major desktop publications also cover networks.

User groups can be found throughout the country; colleges and universities give classes; training companies offer courses by the truckload; local and regional conferences are staged by a variety of organizations;

and vendors give free seminars. In short, a considerable number of alternatives exist today.

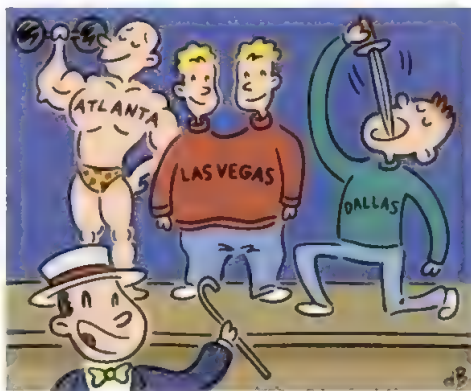
For vendor access, however, the big shows still shine. If you work for a Fortune 100 company, getting vendors to give you evaluation products or visit you isn't all that hard. But if you work for a smaller company, at these larger shows you can talk to more vendors in a shorter amount of time than anywhere else. A major difference turned up between the N+I shows and the Networks Expos: The former were filled with companies hyping ATM, frame relay, SMDS, switching devices, and TCP/IP—a great show floor for the WAN buyer. But the Networks Expos, beside being smaller and more accessible, starred vendors who actually sell applications and products for LANs.

If you're looking for education, ask yourself if you need introductory or overview information, or something more in-depth. Seminars are great for the former; classes are better for the latter.

If you're a NetWare-only person, spend your dollars on BrainShare. It's less technical than it used to be, there are no vendors, and it's probably not worthwhile

going every year. But every two or three years it's a great deal. Just skip the 100-level courses if you're not interested in marketing hype.

If you're looking for products, choose the closest large show and go with an agenda (product categories and questions) or you'll be overwhelmed. Exciting start-up companies have almost disappeared from these shows, but if they're there, they'll be in the least desirable spots: the out-of-the-way rooms or the sides and back of the exhibit floor.



*Smaller regional shows can
actually be better; the quality of the
seminars is generally the same.*

Diane Danielle is an independent networking consultant in Berkeley, California. She can be reached on CompuServe at 70020,645 or MCI Mail at 383-1159.

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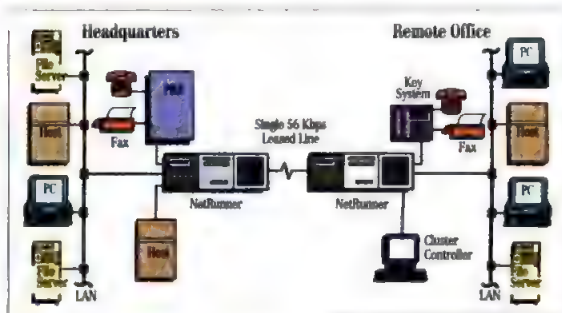


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The Microsoft Payment Plan

David, I've finally figured out the pricing for the Microsoft Windows NT Server Client Access License (CAL). According to Microsoft Corp., the company previously had several different pricing strategies for its file/print server client, SQL server client, SNA server client, and mail server client packages. Now, it has just one pricing strategy: Everything costs something . . . unless it doesn't!

Let me see if I can explain this in the 300 words I've got left. Many folks will be mildly shocked when they learn that after buying Windows NT Server for an anticipated street price of \$699, they'll have to buy a Client Access License for every client that will ever use the NT server file/print or Remote Access Services (RAS). Not every *simultaneous* client—every client. The anticipated street price of a CAL, which is just a piece of paper with legalese on it, not software, is \$39.95.

But wait, there's more! If you want to use Microsoft's SQL Server, SNA Server, or System Management Server (SMS), each of those services has its own separate client license. SQL has an anticipated street price of \$189, SNA is \$64.95, and SMS is \$54.95. Note, says Microsoft, that you only buy what you need, if a client only needs SNA access (oh, sure!) then you only need an SNA license and not a CAL.

Contrary to what you might expect, the NT Workstation package and the Windows for Workgroups package don't come with a CAL, even though each is a server (for 10 nodes) and a client on its own. But since these products and Microsoft Office already come with Microsoft Mail clients, you don't need a separate license for the mail server.

Microsoft anticipates that vendors will bundle CALs with Windows NT Server packages, but the company is doing some bundling of its own. First, customers who want over 100 licenses can buy them in bulk through the Microsoft Select Open License Program. Second, the company has a package called Back Office, with a \$309 anticipated street price, that includes one paper license for file/print, RAS, SNA, SMS, and SQL.

David, Microsoft obviously thinks it'll make money from selling both the razor and the blades. Vendors might be interested in the margins for a zero-support product, but I predict that buyers will expect to get these licenses for free.



Frank Derfler:
*With Microsoft's
new pricing scheme
everything costs
something . . . well,
almost!*



Razors and blades? I guess that's one way to describe what's happening here, Frank. Microsoft's pricing scheme is different, particularly for people who are familiar with NetWare. But it's not entirely all bad and in fact offers some interesting pluses in the changing world of corporate networks.

Here's how I see it. Today's corporate network is composed of multiple servers. Sure there's the traditional file server and print server, but there are also communications servers, fax servers, database servers, and . . . you get the picture. Under NetWare's pricing scheme I need a separate license for each server. So if I'm going to connect to 20 servers, for example, I need to reserve 20 licenses. Hey, that's like paying for 20 razor blades and only getting one.

By paying by user Frank, we avoid this kind of nasty problem. Now network clients can attach to any number of servers and pay only once. Clearly, Microsoft's view of the world says that there are many computers acting as servers of various types, and a client should be able to access all servers of a specific type.

In addition, Microsoft's system keeps the administrative load down while also providing a level pricing scheme. The cost per user is clearly incremental, and you don't "waste seats" by buying a big-

ger package than you actually need.

On the other hand, you have to wonder why NT Server doesn't come with some minimal license for perhaps ten clients to get started, or why you can't order these licenses from Microsoft through an on-line or a fax-back service. Who will be the first smart vendor to offer them electronically?

Microsoft's view of the world is surprisingly realistic. But I've got to wonder if they've considered the total picture. The roaming user is an important factor that I don't see considered in this pricing scheme. Right now I've got a PC at work, one at home, and a laptop for when I commute. Would I need to pay for a separate license for each machine? That's ridiculous. After all, I hardly use all of those systems at once. Under the Microsoft scheme I would still have to pay three times, once for each PC. Moving to a model that takes the corporate site and the roaming user into perspective will be key for Microsoft to make it big with the buyers of razors and blades. □



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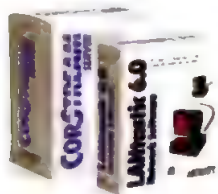
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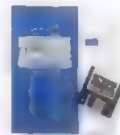
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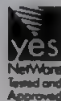
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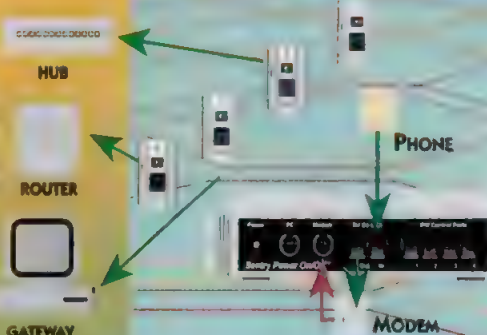


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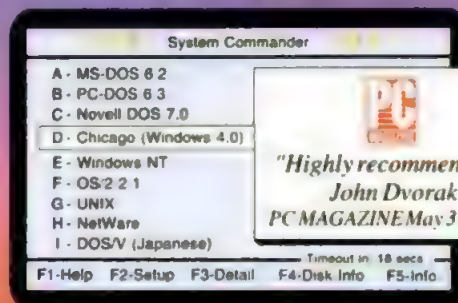
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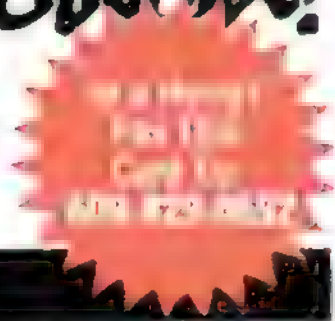
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User-to-User

BY NEIL J. RUBENKING

An Escape Hatch From Ill-Behaved Windows Apps

Sometimes while using Microsoft Windows 3.1, I want to close down a misbehaving application. But this can be a problem if Windows itself doesn't think the application is hung: Ctrl-Alt-Del will not work. There is, however, an undocumented SYSTEM.INI switch for Windows 3.1 that lets you close down an application with Ctrl-Alt-Del, whether or not Windows thinks the program is hung up.

Here's the switch:

```
DebugLocalReboot=TRUE
```

Place it in the [386enh] section of your SYSTEM.INI file. Now if your system beeps when you press Ctrl-Alt-Del, it means Windows thinks the application is not hung up—but you're able to terminate the program anyway.

Kurt Nielsen
Tucson, Arizona

► **PC MAGAZINE:** Everyone who develops applications under Windows should use this .INI file switch. Windows uses cooperative multitasking, not preemptive multitasking. That means a single ill-

behaved application—perhaps one containing an infinite loop—can bring Windows to a halt, and it's all too easy to code an infinite loop by accident. Without the .INI file switch, your only recourse may be to power down the system, losing all unsaved data in all open applications (possibly including the program's source code).

Even if you don't develop your own applications, there's always the chance one of your programs will lock up. Note that if you break out of a program that Windows thinks is working fine, you'll still get a message saying "This Windows application has stopped responding to the system." And of course if you halt a program this way, you will lose any unsaved data in the ill-behaved program.

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Modifying a Set Of Filenames

Some times it would be nice to change a set of related filenames by inserting one or more characters in the middle of the existing names. Suppose, for example, you have a set of files named CHAP1.DOC through CHAP9.DOC, but you later decide you'd rather name them CHAP01.DOC through CHAP09.DOC so that when you create CHAP10.DOC and so forth, the files will sort properly. There is a way to do this automatically using the DOS FOR...DO construct.

The process takes two steps. Using the above example, first you'd issue this command at the DOS prompt:

```
FOR %A IN (CHAP?.DOC) DO REN %A X%A
```

The A in %A can be any letter; the X in X%A can be any character allowed in DOS filenames. (Note that if you use this command in a batch file, every % would have to be %%.)

Then you'd execute the following command:

```
REN XCHAP?.DOC CHAP0?.*
```

In the first step, %A successively takes on the value of each filename matching the file specification in the parentheses. For each, the REN command is executed to replace the existing filename with the same name prefixed with the letter X. This is to make the filename the length it will need to be when the 0 is added in the middle. In the second step, the consistent first part of the filename, XCHAP, is replaced with CHAP0.

If you want to do the same thing but also need to identify specific files to be treated (perhaps because the file skeleton would snare some things you didn't want affected), you could simply list the

actual filenames like this

```
FOR %A IN (CHAP1.DOC CHAP2.DOC
CHAP3.DOC) DO REN %A X%A
```

when you set up the FOR command.

*Douglas A. Kerr
Dallas, Texas*

► **PC MAGAZINE:** The REN command will accept a question mark in the old or new filename, but the character position of the question mark is fixed. If the old filename has a question mark as its third character and the new filename has a Q in that position, the filenames resulting from the REN command will all have Q in the third position. If the new filename has a question mark in the third position, the question mark will also be in the third position in the resulting filenames. Thus, a command like

```
REN CHAP?.DOC CHAP0?.DOC
```

won't work. It will first assign the new filename CHAP0.DOC to CHAP1.DOC (within the command, the question mark in the new filename is ignored, because it doesn't correspond to any character in the old filename). Then the command will attempt to give CHAP2.DOC the filename CHAP0.DOC, but since that filename already exists, it will halt.

Note that you can use the same technique to insert more than one character. For example, to change CHAP to CHAPTER in files named CHAP1.DOC through CHAP9.DOC, use these commands:

```
FOR %V IN (CHAP?.DOC) DO REN %V XXX%V
REN XXXCHAP?.DOC CHAPTER?.DOC
```

Also, you can make the insertion anywhere in the filename. Suppose you've used the names CHAP01.DOC through CHAP99.DOC and you wish to change them to the form CHAP0001.DOC. Use the following command:

```
FOR %%V IN (CHAP???.DOC) DO REN %V XX%V
REN XXCHAP???.DOC CHAP000???.DOC
```

When the number of files involved is large, this technique can save a lot of time and aggravation.

A Bug in DOS 6's CONFIG.SYS Menus

While attempting to share a new CD-ROM drive across my Microsoft Windows for Workgroups network, I encountered a serious bug in MS-DOS 6.2's menu system. I had set up the menu system to run with two choices (with and without buffers), and I had a menu default time-out of 10 seconds. I was experimenting with two different CD-ROM device drivers in the CONFIG.SYS file, using the DEVICE?= command, which prompts for a [Y/N] response. I put both drivers in the CONFIG.SYS file, each with the DEVICE?= command, to configure the system optimally.

At the initial menu prompt, I manually chose the correct menu by pressing the Enter key and then selected one of the two drivers. This worked properly. I then rebooted and went to get a cup of coffee, expecting that the menu time-out default would select the correct menu item and stop at the first DEVICE?= line. Much to my dismay, the computer started beeping and hung up.

What I discovered is this: If you let the default time-out run its course, then *all* the DEVICE?= commands are executed! Both my device drivers had loaded, causing a system crash. As long as you terminate the menu manually before the time-out reaches 0, everything works. But if you let the time-out reach 0 and process the default menu, it seems that all the DEVICE?= commands become DEVICE= commands and load.

I haven't yet found a solution for this problem. Do you have any ideas?

*Gerry Dorman
Lindenhurst, New York*

► **PC MAGAZINE:** DOS 6.0 introduced a number of options for fine-tuning CONFIG.SYS. If you load a device driver with DEVICE?= rather than DEVICE=, DOS will stop when it reaches the line and prompt for confirmation. It will load the device driver only if you respond with Y for yes. DOS 6.0 also introduced a number of new CONFIG.SYS commands that let you create a menu for loading different

configurations. And as Mr. Dorman has noted, these two features don't work well together, in DOS 6.2 or DOS 6.0.

To see the problem, rename your CONFIG.SYS file and then replace it with the text in Figure 1. Reboot your system, and when the menu appears, select option 1. You'll be asked whether you want to load ANSI.SYS. Now reboot again, but this time let the menu time out. DOS will load ANSI.SYS without asking. Oddly enough, I found that when Quarterdeck's DOSDATA.SYS driver is loaded, this problem does not occur.

The solution here is to avoid using the DEVICE?= feature in a CONFIG.SYS file that has a menu. You can get the same effect using only the menu features. Figure 2 shows a stripped-down menu system that lets you choose whether or not to load ANSI.SYS with-

```
[menu]
menuitem=Maybe_ANSI, Maybe ANSI.SYS
menuitem=No_ANSI, No ANSI.SYS
menudefault=Maybe_ANSI, 5
```

```
[Maybe_ANSI]
DEVICE?=C:\DOS\ANSI.SYS
```

```
[No_ANSI]
```

Figure 1: This simple CONFIG.SYS file demonstrates an incompatibility between DOS 6.x's menu system and the DEVICE?= command.

```
[menu]
menuitem=With_ANSI, With ANSI.SYS
menuitem=No_ANSI, No ANSI.SYS
menudefault=With_ANSI, 5
```

```
[With_ANSI]
DEVICE=C:\DOS\ANSI.SYS
```

```
[No_ANSI]
```

```
[Common]
SET PROMPT=$e[33;44;1m$P$Q
```

Figure 2: This stripped-down CONFIG.SYS avoids problems by using the menu system itself to choose whether or not to load a particular driver.

out using the DEVICE?= feature. CONFIG.SYS lines common to both menu choices reside in the [Common] section. In Mr. Dorman's example, menu choices would select one or the other of the CD-ROM drivers, while all other CONFIG.SYS commands would reside in the [Common] section. □



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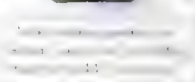
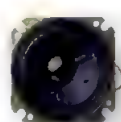
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Tutor

BY JEFF PROSISE

DMA and Memory Managers

Interruptions and IRQs get a lot of attention in the computer press these days, but there's another important facet of your PC's operation that doesn't: DMA, or direct memory access. DMA is one of those mysterious terms like IRQ (interrupt request) that it seems everyone has encountered but few can explain.

Understanding DMA is more than an academic pursuit. When you add a new sound board or other adapter to your PC, you may be asked to choose a DMA channel. How do you know which channel to select, and what are the consequences of picking the wrong one? To answer these questions, we'll discuss what DMA is, how it works, and how it is used on today's PCs. We'll also discuss the interaction between DMA controllers and 386 memory managers and reveal the true meaning of the D= switch supported by DOS's EMM386.EXE driver.

WHAT IS DMA? DMA is a mechanism for transferring data very quickly from an adapter card to memory, from memory to an adapter card, or, in some cases, from one location in memory to another. DMA transfers are important because they don't require the CPU to perform them. DMA transfers are performed by programming a chip called a DMA controller, which is located on the system board of every PC. The programming is usually done by a program running on your PC (for example, a hard-disk backup program) or by a routine stored in the ROM on one of your adapters (for example, the ROM on a floppy disk drive controller). Once the controller is initialized and the data transfer begins, the CPU is free to go off and do other things while the DMA controller completes the trans-

fer. During the brief periods of time in which DMA transfers take place, you essentially have two processors working on your behalf: One executes code, and the other moves data.

DMA transfers are also important because they transfer data directly between the source and its destination without involving any intermediate storage locations. Transferring a byte of data from an adapter to a memory location via the CPU is a two-step process. First the CPU reads the byte from the adapter and stores it in one of its internal registers. Then it writes the byte from the register to the proper address in memory. A DMA controller reduces this to one step, manipulating the control signals on the bus so that the byte is read and written in one operation.

A good way to understand the difference is to picture the CPU as a baseball player playing catch with two other players, whom we'll refer to as player A and player B. To get the ball from player A to player B, the CPU would catch the ball thrown by player A and throw it to player B. A DMA controller, on the other hand, would tell player A to throw the ball directly to B. Meanwhile, the CPU could do other things, such as warming up for the next batter.

Memory-to-memory DMA transfers are rarely used anymore because today's CPUs are so fast they can outperform DMA controllers. But memory-to-adapter and adapter-to-memory transfers

are commonplace. To transfer data from an adapter to memory, the DMA controller simultaneously activates the bus line that triggers a read from the adapter (an operation known as an I/O read) and the bus line that signals a write to memory. Activating the I/O read line causes the adapter to place one unit (typically one byte or one word) of data on the PC's data bus. And because the memory write line is active at the same time, the data is simultaneously copied from the data bus to memory. With each individual write, the DMA controller manipulates the bus's address lines to specify the address in memory where the data will go.

A DMA transfer from memory to an adapter takes place in a similar manner. For each unit of data that is transferred, the DMA controller activates the bus lines signifying a memory read and an I/O write. The memory address is placed on the address bus. As in an adapter-to-memory transfer, the data moves directly from the source to the destination using the data bus as its conduit.

The DMA controller used in most PCs

DMA, or direct memory access, is one of those mysterious terms like IRQ that it seems everyone has encountered but few can explain.

is a chip called the 8237A or an equivalent. (Micro-Channel and EISA PCs feature custom DMA controllers that are functional supersets of the 8237A, but few programs or devices take advantage of their expanded capabilities.) The original IBM PC and its successor, the XT, used just one 8237A, which provid-

ed four separately programmable DMA channels numbered 0 through 3. AT-class machines, which include most of the PCs on the market today, use two 8237As to provide eight independent DMA channels numbered 0 through 7. Only seven of the eight channels are usable, because one—channel 4—is used to link the two controllers together so they can work as a unit. Channels 0 through 3 transfer 8 bits of data at a time and can handle up to 64K of data in a single operation, while channels 5 through 7 transfer 16 bits at a time and can transfer up to 128K.

Like an interrupt controller, which re-

ceives interrupt requests from other devices via interrupt request (IRQ) lines, a DMA controller receives DMA requests through DMA request (DREQ) lines. The 8237A supports several different modes and methods of operation, but a typical adapter-to-memory transfer transpires as follows: The DMA controller is first programmed with the memory address that data will be written to and the number of bytes that will be transferred. When the adapter is ready to begin the transfer, it activates the DREQ line that connects it to the DMA controller. After getting permission from the CPU to take control of the bus, the DMA controller outputs the memory address and transmits control signals that cause a byte (or a word) of the data to be read from the adapter and written to the specified memory location. Then it updates the memory address to point to the next byte (or word) in memory and repeats the process until all the data is transferred. Depending on how the controller is programmed, each byte transfer might require a separate DREQ signal (single-transfer mode), or just one DREQ signal may initiate all of the transfers (block- or demand-transfer mode).

The one DMA device present in nearly every PC is the floppy disk drive controller. Floppy disk data is read in units of sectors (512 bytes) and transferred to memory via DMA using DMA channel number 2. To read a sector of data, the interrupt 13h BIOS programs the DMA controller for single-transfer mode and issues a read command to the floppy disk drive controller. The drive controller, in turn, reads the first byte of data from the disk and initiates a transfer by activating DREQ2. Then it reads another byte, and another, and another, each time activating DREQ2 to transfer the byte to a physical location in memory. When all 512 bytes have been copied, the DMA transfer ends and the drive controller issues a hardware interrupt notifying the CPU that the sector is now available.

CHANNEL SURFING, DMA-STYLE When you plug an adapter that utilizes DMA into your PC, you're usually given a choice of DMA channels. Setting a DIP switch or jumper for DMA channel 5 establishes a physical connection between

the adapter and the DMA controller through DREQ5. Often, software that uses the adapter must be informed of the DMA assignment so that it can properly program the DMA controller for DMA transfers. Although it's theoretically possible for adapters to share a DREQ line if they won't use the line at the same time, as a rule it's best to limit each channel to one adapter. This way you're assured there will be no DMA conflicts.

We've already established that DMA

it's up to you to keep track of DMA assignments and ensure that no two adapters use the same DMA channel. I keep a list of all my PC's IRQ and DMA assignments in a desk drawer. When I go to add a new adapter and need to find an unused IRQ line or DMA setting, I don't have to yank out the old adapters and look at their jumper settings. There are a few utilities for determining which channels are used, but none of them is completely reliable.

Default DMA Usage

Channel	Width (bits)	Device
0	8	Unused or unimplemented on most PCs (used for memory refresh on early PCs)
1	8	Unused
2	8	Floppy disk drive controller
3	8	Unused on most PCs (used by the hard-disk controller in XTs)
4	16	Cascade line linking DMA chips
5	16	Unused on most PCs (used by the hard-disk controller in PS/2s)
6	16	Unused
7	16	Unused

Figure 1: The default DMA channel assignments. Channels 4 through 7 are not available in early PCs. Channels 1, 3, 5, 6, and 7 are free to be allocated to sound boards and other adapters in most cases. A DMA channel should be allocated to just one device.

channels 2 and 4 are off limits because they're dedicated to the floppy disk drive controller and the line connecting the two DMA chips. Channel 0 was off limits in early PCs because it was used for memory refresh. (At start-up, the original IBM-PC BIOS programmed a timer to issue a dummy DMA read request—one for which a memory read is performed but no adapter is present to pick up the data—every few microseconds in order to prevent DRAM from losing its memory as a result of current leakage.) Most present-day PCs perform DRAM refreshes without help from the DMA subsystem, but you can't universally count on channel 0 being available, because some PCs simply don't implement it. So where do you turn when asked to pick a DMA channel?

The remaining channels are generally yours for the picking. Figure 1 lists the default DMA channel assignments. On most PCs, channels 1, 3, 5, 6, and 7 are available to be assigned to an adapter. PS/2s use channel 5 for hard-disk transfers and XTs use channel 3, so you'll want to avoid those channels if you use either of these PCs. As long as you haven't assigned an empty DMA channel to another adapter, you're free to assign it as you please. But

If you haven't a clue how DMA channels are assigned in your PC and don't care to go digging through your manuals, there are a number of diagnostic programs available that will analyze your PC and list allocated DMA channels. But none of these programs is perfect, so there may be discrepancies between actual and reported DMA usage.

MEMORY MANAGER PROBLEMS Virtual-86-mode memory managers such as EMM386.EXE, QEMM-386, and 386Max present a special problem for DMA controllers. Memory addresses programmed into DMA controllers in preparation for DMA transfers are physical addresses. But memory managers frequently remap the memory in your PC so that a given memory address actually corresponds to some other physical location, usually one somewhere off in extended memory. When a program accesses a remapped memory address, the CPU transparently reroutes the request to the appropriate physical address. Still, if a DMA controller tries to access the same address, the memory access will go awry because the DMA controller has no way of knowing that the address has been remapped.

The upshot of all this is that DMA in-



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volving programs with data buffers loaded in upper memory blocks (UMBs) wouldn't work if not for some fancy footwork on the part of the memory managers. A DMA controller is programmed by outputting data to I/O ports, and in V86 mode a memory manager can intercept all data sent to I/O ports. By doing so, it can anticipate forthcoming DMA requests and even determine what memory addresses will be involved. If those addresses have been remapped, the memory manager quietly reprograms the DMA controller with the corresponding physical memory addresses. Then it allows the DMA transfer to proceed, and all works as normal.

A potentially disastrous situation occurs when the physical memory addresses to which the DMA transfer must be redirected lie outside the range of the DMA controller. Most DMA controllers are restricted to 16MB of memory, and some can't address more than 8MB. When the source or destination memory address lies outside the addressable range of the DMA controller, the memory manager pulls out trick number two: It redirects the DMA transfer to a buffer owned by the memory manager itself—one that is within the range of the DMA controller—and lets the transfer proceed. If the buffer is large enough to hold the data, then after the DMA transfer has finished, the memory manager transfers the buffered data to the appropriate memory addresses. This greatly reduces the effectiveness of DMA transfers, but it keeps things running.

The real trouble occurs when the DMA transfer exceeds the buffer size. You'll typically receive an error message warning you to increase the size of your memory manager's DMA buffer, followed by a complete lockup. That's the work of the memory manager, which is trying to avert data loss. By default, EMM386.EXE uses a 32K DMA buffer size. The buffer size can be set from 16K to 256K using the D= switch. The default DMA buffer size is usually fine, because it

takes an extreme set of circumstances for the DMA buffer to come into play at all.

An even more difficult situation arises when the DMA controller is not on the system board but on the adapter itself where the memory manager can't feasibly monitor output to the DMA controller's I/O ports. This is the case with bus-mastering hard-disk controllers. These controllers caused a lot of problems in MS-DOS 5.0 when users everywhere started using SmartDrive and loading it in upper

memory. The solution came in the form of Microsoft's VDS (Virtual Device Services) specification, introduced in 1990. VDS is a set of services that let the memory manager provide system memory addresses to a bus-mastering controller prior to reading or writing.

The controller has to be VDS-aware, of course, but it seems that most now are. This is all pretty complicated stuff, but the bottom line is that it is now almost always safe to use DMA devices in systems using V86-mode memory managers.

FURTHER READING If you'd like to learn more about DMA and, in particular, how DMA chips are programmed, let me suggest two further sources of information. The first is a recently published book by Hans-Peter Messmer entitled *The Indispensable PC Hardware Book* (1994, Addison-Wesley). This book is a masterpiece, and it has virtually replaced the half dozen or so hardware reference manuals I used to have lying around my office. It spares no detail in describing how the hardware components of your PC work, including the chips on the system board. And despite the fact that it was translated from German, it is exceptionally readable.

The second book is Frank van Gilluwe's *The Undocumented PC* (1994, Addison-Wesley). Though not quite as comprehensive as the Messmer book, *The Undocumented PC* is a treasure trove of heretofore hard-to-find information about PCs. Both books deserve places on the shelf of the serious computerphile and, as far as I'm concerned, are unequaled in their field. □

The bottom line is that it is now almost always safe to use DMA devices in systems using V86-mode memory managers.

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CIRCLE 399 ON READER SERVICE CARD

Lab Notes

BY MARK L. VAN NAME AND BILL CATCHINGS

Reaching New Heights in Benchmark Testing

The hardware reviews in this issue introduce Winstone 95, Version 1.0; WinBench 95, Version 1.0; and PC Bench, Version 9.0. These new releases of our main three benchmark test suites for PCs represent more than a year of research and development by the Ziff-Davis Benchmark Operation (ZDBOp) and PC Magazine Labs. Together, these tools give *PC Magazine* an even greater ability to analyze and predict PC performance.

Winstone 95, a major update of Winstone 94 (our first publicly available applications-based benchmark test), provides an overall measure of a PC's performance under Microsoft Windows. Its companion, WinBench 95, paints a detailed portrait of a machine's graphics and disk performance under Windows. PC Bench 9.0 helps you gauge a system's overall DOS performance while also supplying a wealth of details.

Like their predecessors, these tools attempt to predict the performance that typical users (those in the center of the market) will see when carrying out common operations with widely used applications, such as word processors and spreadsheets. This orientation makes the test results useful to a broad range of people—but not everyone. If you spend all your time running CAD programs or doing video production, the benchmarks' main scores (like the ones we publish) won't necessarily reflect your work—but often the individual test scores will still prove useful.

The benchmark tests take two different approaches to performance evaluation. To give a picture of real-world Windows performance for the PC as a whole, Winstone 95 is applications-based. It derives its scores from the time consumed by best-selling software packages running through a series of scripted activities. WinBench 95 and PC Bench, by contrast, measure the performance of individual subsystems. To do so, they need to be synthetic benchmarks—programs that simulate “real” applications but stress the display, disk, and other subsystems one at a time.

LOOK AND FEEL

Users of our current benchmark tests (about three-quarters of a million people) will feel right at home with the new versions of the two Windows-based benchmark programs, since we've kept the same basic look and feel. The interfaces of all three products, though, are considerably more consistent with one another. In fact, Winstone 95 and WinBench 95 share the same interface; use one and you pretty much know how to use the other. Even PC Bench 9.0 resembles its siblings more closely, despite the limits DOS imposes on its graphics capabilities.

Also, the benchmarks now save their individual result files in a common directory (\zdbench\results) and in dBASE-

compatible format. Each benchmark lets you read its previously stored results, allowing you to make comparisons with earlier test runs. To assist you, the products provide simple query features. You can, for example, quickly locate scores for all 486-based PCs or all the systems from a specific vendor. You can even use features built into the benchmarks to display results graphically or to export them for use with Microsoft Excel and other spreadsheet programs. For comparison purposes, results will be available (in the dBASE-compatible results format just mentioned) for downloading from online services such as ZiffNet and Interchange and also on editions of the *PC Magazine* CD.

Other improvements include bug fixes and major enhancements to the code that inspects a system's configuration, allowing the benchmarks to detect more details. They now identify, for example, the latest generation of x86-compatible processors—the current Pentium chips, NexGen's Nx586, and others. This information goes into the standard results

database, so you can track any elements that change between test runs or just check out the configuration of a tested system.

We've also dramatically expanded the documentation. Each benchmark test or suite comes with an on-line help facility that contains the vast majority of what you'll find in its comprehen-

sive printed manual (available separately; see the sidebar “How to Get the New Benchmarks”). We've reorganized the manuals, too, making them more task-oriented and simpler to use than ever. Complete copies of all three manuals are available on the CD-ROM for viewing or printing.

MOVING ON The industry moves on. New applications and new versions appear, and they stress systems differently from the old programs. For our benchmark tests to be accurate gauges of system performance, they must change with the applications—which also means that the

For our benchmark tests to be accurate gauges of system performance, they must change with the currently popular applications.



Figure 1: Winstone 95 provides not only an overall measure of system performance but also four category scores to help you find performance metrics that reflect the way you work.

results they produce change. Thus, you can't make meaningful comparisons against the results of any previous benchmark tests—not even earlier versions of the same benchmark. Don't attempt, for example, to relate the output of WinBench 4.0 to that of WinBench 95. (The temptation is especially great here, since the overall scores from the two versions may look similar. They aren't. The two benchmark suites model the execution profiles of different applications or different versions of the same applications, and they use different scripts and different weightings.)

Although it's time to move up from last year's benchmarks, this upgrade—unlike most—is free. We'll be using only the new versions from this issue on. Encourage your vendors to do the same: If they quote results from old benchmark tests, ask for new ones.

GETTING REAL VALUE Running the tests is easy. Producing useful output takes some care, though, because the way you test affects the outcome. The manuals outline standard procedures we use (and recommend that you follow) to make the results both accurate and highly repeatable gauges of a system's potential. Key guidelines include defragmenting the system's disk, making sure no other applications are active, and rebooting between runs. Follow the proper procedures for multiple runs of a selected test suite and none of the major scores will vary by more than a few percent.

Even when you have results, though,

part of the picture is still missing: context. It does little good to know that a system delivered an overall Winstone 95 score of 50 if you have no idea how other systems fared or how they were set up. Our reviews provide multiple results for just that reason—so you can make meaningful comparisons. Similarly, they give extensive configuration information so you get an idea of the range of results that different systems can produce. Make sure vendors provide the same type of configuration data when they cite benchmark scores. (The benchmarks' license agreements require them

to do just that.)

To get any value from the benchmarks, your comparisons must be meaningful. If, for example, you want to compare the performance of two graphics adapters, you must test both in the same system (or two identical systems). If you test the boards in different machines—say, a Pentium PC and a 386—the differences in the test-beds will cloud the results.

WINSTONE 95 Winstone 95 is the flagship of our PC benchmark test family (see Figure 1). To determine which Windows applications to run in Winstone 95, we consulted with InfoCorp, a leading market research firm and another division of Ziff-Davis, our parent company. Using that data, we averaged each application's 1994 unit market share to date (the number of packages actually sold) and a projection for 1995 that InfoCorp prepared for us, selecting the products with the highest average. The result was a set of 13 applications. Among them, 12 fall into one of four possible categories, as shown in this alphabetical list:

Business Graphics/Desktop Publishing

- Aldus PageMaker for Windows, Version 5.0a
- CorelDRAW, Version 5.0
- Microsoft PowerPoint for Windows, Version 4.0

Database

- FileMaker Pro 2.12 for Windows

- Microsoft Access for Windows, Version 2.0
 - Paradox 4.5 for Windows
- Spreadsheet**
- Lotus 1-2-3 for Windows, Release 4.01
 - Microsoft Excel for Windows, Version 5.0
 - Quattro Pro for Windows, Version 5.0
- Word Processing**
- Ami Pro for Windows, Version 3.01
 - Microsoft Word for Windows, Version 6.0a
 - WordPerfect 6.0a for Windows

To reflect the way people use the thirteenth product (Microsoft Works for Windows, Version 3.0), we spread its weight across three categories: Database (20 percent), Spreadsheet (40 percent), and Word Processing (40 percent).

Earlier versions of all the software listed (with the exception of Ami Pro) were in Winstone 94. Each Winstone 95 application was the latest revision available when we started testing for this issue. To reflect changes in the applica-

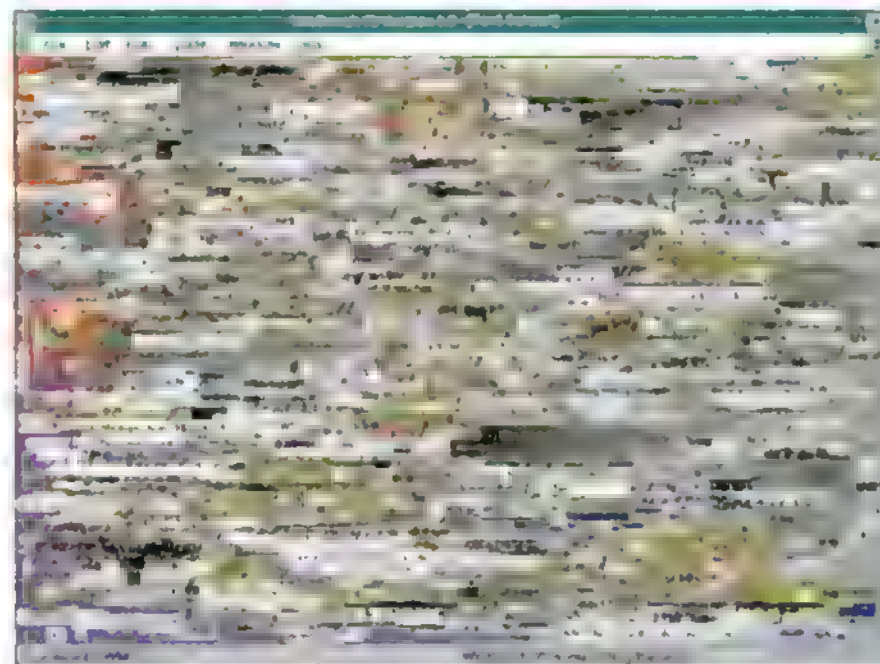


Figure 2: The "mess" on this screen shows what WinBench 95 looks like while stressing the video subsystem. WinBench 95 uses the latest in profiling technology to stress the video subsystem (and the disk subsystem as well) the same way leading applications do.

tions, we updated Winstone 95's scripts where appropriate. For example, the benchmark now exercises Windows' OLE capability courtesy of the Access and PowerPoint scripts. (Both applications use OLE to communicate with their graphing modules.)

As you might imagine for a benchmark test that contains significant parts of 13 leading applications, the new Winstone program is big. On-line and disk distribution were not practical options for a prod-

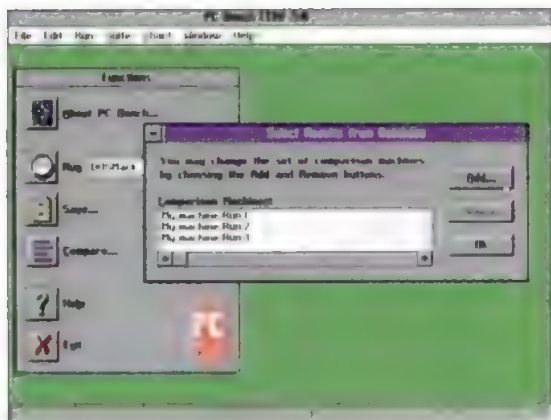


Figure 3: PC Bench 9.0 sports an improved user interface and better results storage and retrieval capabilities, along with updated tests that reflect the latest profiling information.

uct with well over 100MB of data, so (like its predecessor) Winstone 95 is available only on CD-ROM.

The benchmark runs on the system being tested in as little as 4MB of RAM (although we strongly recommend 8MB or more), and it can be loaded in one of three ways: from a local hard disk, from an attached CD-ROM drive, or from a network server. Winstone 95 copies the files needed to execute each application to a working directory (which should have about 35MB free) on the system being tested, then runs the script for each application from the same directory. The benchmark does not measure the time taken to copy the files, ensuring that all three methods produce the same result on a given system.

With last year's Winstone, all scores were normalized against a Compaq Deskpro 386/25M with 4MB of RAM, whose score was set at 10.0. (We chose that system as our reference machine because this type of setup is the least powerful that can still run Windows adequately.) A machine that scored 20.0 on Winstone 94, for example, was twice as fast as the reference machine.

The same still holds for Winstone 95's overall score, but we've added a new feature—category scores. When you run the complete test suite, it produces both an overall result and a result for each of the categories mentioned earlier. Category scores are normalized with respect to the same reference machine as the overall score—but against a value of 1.0 rather

than 10.0, so it's usually easy to tell the difference. (The license agreement also requires anyone quoting a category score to quote the overall score.) We'll take a brief look at the calculation process here.

Winstone 95 produces its overall system score in much the same manner as Winstone 94. It records the time an application takes to complete a script running under Microsoft Test (Microsoft's software-testing product), then normalizes that result against the score of a reference machine. (Normalization converts the timing to a performance score relative to

the Compaq's score.) The process repeats for each of the 13 applications, with Winstone weighting each score according to the application's unit market share in a category. Each category result is a harmonic mean of the appropriate scores. Winstone 95 uses the unit market-share weights of the categories along with the category scores to calculate the overall score—another weighted harmonic mean—which it normalizes against the reference machine's overall score (which is arbitrarily set at 10.0). For those interested in the details, the Winstone 95 manual contains the weights for each of the categories (approximately 21.5 for Business Graph-

ics/Desktop Publishing, 20.0 for Database, 28.0 for Spreadsheet, and 30.5 for Word Processing) and the complete formulas for all these calculations.

Other technical enhancements help make Winstone 95 a state-of-the-art applications-based benchmark. For example, scripts now run at the system's current graphics resolution rather than being stuck in a 640-by-480 area of the display's upper-left corner, as they were last year.

If the new Winstone anticipates trouble running in a given environment, it does a better job of warning you than the previous version did. Before the benchmark program runs a test, it thoroughly checks the system's state to ensure that the test will work properly. If it detects a possible problem—too little RAM, not enough disk space, missing fonts, inadequate Windows resources, and so on—it warns you and gives you the option of continuing (knowing the test may not complete) or stopping to fix the problem.

WINBENCH 95 WinBench 95 is a synthetic gauge of graphics and disk performance for Windows PCs (see Figure 2). It is still market-centered, since its two main scores—the Graphics WinMark 95 and Disk WinMark 95 scores—come from tests designed after extensive profiling (logging and analyzing) of the graphics and disk activity of the Winstone 95 applications.

■ What's New in Winstone 95

By Mark L. Van Name and Bill Catchings

- Winstone 95 includes 13 applications: the 12 that were in Winstone 94 plus Ami Pro.
- Winstone 95 provides five scores rather than one. In addition to the overall Winstone 95 score, scores are produced for four application categories: Business Graphics/Desktop Publishing, Database, Spreadsheet, and Word Processing.
- The applications in Winstone 95 are the versions current as of the time testing began.
- Winstone 95 uses market-share

data for 1994 and projections for 1995.

- Winstone 95 runs on Microsoft Windows 3.1 and Windows for Workgroups 3.11.
- Winstone 95 supports the new format for Ziff-Davis benchmark test results that WinBench 95 and PC Bench 9.0 also use. This common format simplifies the process of saving and comparing results and allows for easier distribution of results on CD-ROMs and on-line services.
- Winstone 95 includes a limited query facility that lets users select results to view and compare. □

WinBench's most widely used score has been the Graphics WinMark score, so this year we wrote our own tools, which profiled Winstone's graphics operations in a level of detail not previously possible. Our profiling produced hundreds of megabytes of data, which we analyzed with other specially created software. As a result, the new Graphics WinMark tests mimic the way applications use graphics (and color) more accurately than ever before.

WinBench 95's Graphics WinMark 95 consists of 13 tests. Each involves a mix of different Windows graphics manipulations—a total of 102 different operations, of the type performed by applications running through Winstone 95 scripts. These range from the visible (such as painting lines on the screen) to the invisible (such as writing to off-screen memory or clipping). The frequency, parameters, and weight of each operation are determined from our Winstone profiling.

Although each operation plays the same role in the Graphics WinMark 95 tests as in the overall graphics performance of Winstone 95, the Graphics WinMark score is by no means the same as any of the Winstone scores. It comes from a series of nearly nonstop graphics stress tests—harsher treatment than graphics adapters get under Winstone (in which applications spend only part of the time performing graphics operations). This stress-test approach can make WinBench

95 scores appear much lower than those of previous versions, but as we noted earlier, such comparisons are inherently inappropriate. Each version of WinBench reflects profiling of a different Winstone; thus the results of WinBench 95 are not comparable with those of the previous version.

The other main result of WinBench 95, the Disk WinMark 95 score, comes from an entirely new set of tests that push the Disk Mix technology (introduced last year) to its logical conclusion by replaying *all* the timed application disk activity in Winstone 95. The tests use over 50 directories, almost 1,000 files, and about 40MB of disk space. WinBench 95 (unlike Winstone 95) is not sensitive to the amount of RAM in a system as long as the machine has enough for the benchmark tests to run without having to swap. Systems with 8MB or more will typically run the benchmark tests with no swapping.

In case you want more detail than the Graphics WinMark score or the Disk WinMark score can provide, WinBench 95 offers hundreds of other detailed tests. Most measure graphics performance, with

tests available for just about every Windows graphics operation.

PC BENCH 9.0 PC Bench 9.0 is a synthetic benchmark suite based on profiling of leading DOS applications (see Figure 3). Its main result, the DOSmark score, reflects the overall performance of a DOS machine and is a weighted harmonic mean of the CPUmark₁₆, DOS Video, and DOS Disk scores. In preliminary testing of PC Bench 9.0 on nearly 100 machine configurations (with and without SmartDrive active), the DOSmark corre-

lated extremely well with the performance of the profiled applications.

PC Bench 9.0's CPUmark₁₆ uses the same Large Instruction Mix as in the PC Bench 8.0 processor tests. This year, however, we scaled the score in order to make its meaning more intuitive. Most

486DX2/66 processors will produce scores between 70 and 85—just above their MHz ratings. (The range occurs because this test measures the complete processor subsystem including the RAM, cache, and processor; thus different systems with the same processor will return different scores.) This score will be used by *PC Magazine*, other Ziff-Davis publications, and a variety of processor and system vendors. Since it gives a much clearer picture of processor performance than the increasingly meaningless megahertz rating, we'll be working with vendors to make CPUmark₁₆ the new industry standard.

The DOS Video score in PC Bench 9.0 is a weighted harmonic mean of both a Graphics Mix test and a Text Mix test. Each of these mixes of read and write operations uses a blend of 8- and 16-bit screen accesses, just as the profiled applications do.

PC Bench 9.0 produces its DOS Disk score by replaying the profiled disk activity of leading DOS applications. The tests use 28MB of disk storage, involve over 100 directories and nearly 1,000 files, and (thanks to the same updated Disk Mix technology found in WinBench

*A visibly dramatic
improvement to PC Bench
makes the benchmark suite
look and feel much like
Winstone 95 and
WinBench 95.*

■ How to Get the New Benchmarks

By Mark L. Van Name and
Bill Catchings

If you'd like copies of WinBench 95 or PC Bench 9.0, you can download them from ZiffNet. Both benchmark test suites are available in the Ziff-Davis Benchmark Forum (GO ZD-BENCH). Winstone 95, which is well over 100MB, is not available for downloading. To get a copy of the CD-ROM that contains all three benchmark suites, send a postcard to Ziff-Davis Benchmark Operation One Copley Pkwy., #510 Morrisville, NC 27560 Attn.: Distribution Coordinator

You can also fax your request to 919-380-2879.

With all requests, please include your name, address, and phone number, and the fact that you want the PC benchmarks CD-ROM. Allow four to six weeks for delivery. If you'd like faster delivery, enclose your Federal Express account number and Federal Express shipping instructions.

The benchmark CD-ROM includes on-disk manuals for all three benchmark suites. You can also obtain a printed and bound copy of any suite's manual for \$10 (\$20 outside the U.S.), including postage. □

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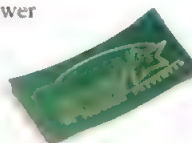
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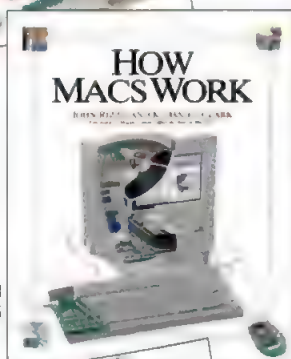
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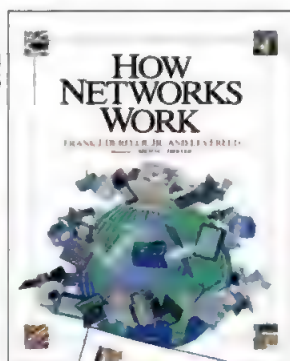


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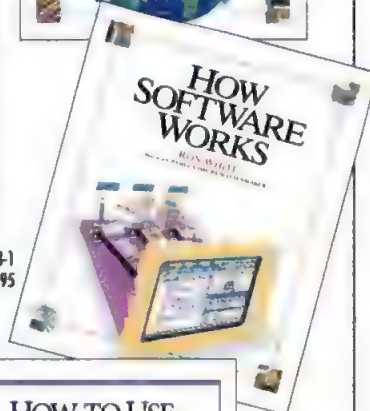
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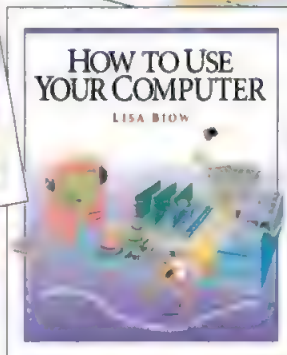
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PUTTING THE TESTS TO GOOD USE

The results of these benchmark tests will appear regularly in our pages as performance measures of PCs and peripherals such as graphics adapters and disk drives, but you can use them to get a handle on other aspects of system performance as well. For example, we wanted to get a feel for the optimal amount of RAM to put in a 486DX2/66 using Windows for Workgroups 3.11, so we ran Winstone 95 on the machine several times, adding memory between runs. The overall score grew for a while as RAM increased, but then it stopped appreciating. The score was only 22.1 with 4MB of RAM, but it jumped to 52.9 with 8MB, 68.7 with 12MB, and 71.5 with 16MB. When we jumped from 16MB to 24MB, though, the results were basically the same. Our findings showed us that, for maximum performance with typical Windows applications, 16MB was all the RAM necessary, and we could achieve over 90 percent of maximum performance with only 12MB of RAM.

THE FUTURE Our new benchmark tests improve substantially on their predecessors, but the coming year promises a flood of new technologies. We'll be busy creating the tests necessary to help you and us cope with the changes. □

BILL CATCHINGS AND MARK L. VAN NAME ARE THE CODIRECTORS OF THE ZIFF-DAVIS BENCHMARK OPERATION, A RESEARCH AND DEVELOPMENT DIVISION OF ZIFF-DAVIS THAT WORKS WITH PC MAGAZINE AND OTHER ZIFF-DAVIS PUBLICATIONS TO PRODUCE PUBLICLY AVAILABLE BENCHMARK TESTS. THEY ARE THE COAUTHORS OF COLUMNS IN PC WEEK (LOOKING FORWARD) AND COMPUTER SHOPPER (HANDS-ON TECHNOLOGY).

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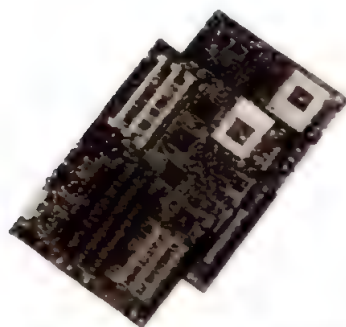
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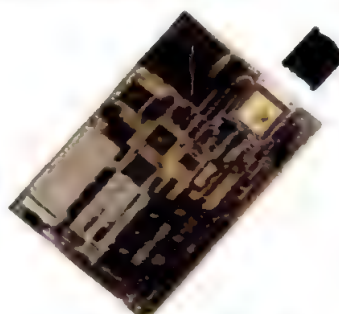
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CIRCLE 390 ON READER SERVICE CARD

Corporate Developer

BY ROBERT KENDALL

Creating Talking Help for Your Database

In the last Corporate Developer (October 25, 1994), we looked at ways of incorporating audio into a Windows database interface to make life easier for end users. Here we'll show you how—with the aid of a sound board—you can create a system of customized audiovisual help. The user can learn your application by watching elements of the interface and data-entry process demonstrated graphically, while listening to a spoken explanation.

We've used Paradox for Windows for this demonstration, but this system can be adapted to other Windows databases (such as Microsoft Access) that have programming languages that can directly access DLLs. We'll build our example around a couple of the sample databases bundled with Paradox. Figure 1 shows our sample order entry form, which is based on ORDERS.DB. We've linked this table to LINEITEM.DB, which we've embedded in our form under the label Items Ordered.

Our help system follows the slideshow-with-voiceover metaphor. A help database stores a graphic and a digital audio .WAV file for each help screen. The user moves through the records one at a time—either manually or automatically—to view the images and listen to the accompanying recorded speech. The help system is both menu-driven and context-sensitive.

Normally you'd use OLE fields to store sound in a database, but we'll use an alternative approach that allows much

greater program control over playing the sounds. Our database will hold only the names of the .WAV files and will use the Windows API function `sndPlaySound()` to play the files.

DESIGNING TALKING HELP The first step in designing your help system is to decide on its contents and create the appropriate graphics and audio recordings, grouping them by topic. You can include as many topics or images in your help database as disk space will allow.

Use a screen-capture program to create pictures of the parts of your application you want to elucidate. Then with a graphics editor, crop each image to an appropriate size and, if you wish, add arrows or other markings for emphasis. You should also create an introductory welcome screen, such as the one shown in Figure 2. Using a microphone and the Windows Sound Recorder applet, record the commentary for each graphic, creating a separate .WAV file for each image. The length of the commentary accompanying a help screen will determine how long that particular screen is displayed when the help system is in Auto mode. When the .WAV file is done playing, the next image will be shown. Be sure to make each commentary long enough to let the user get a good look at the com-

panion screen. You can insert a silent pause at the end of the .WAV file if necessary.

For our example form, we've created a Payment Method help category. The screen in Figure 3 depicts the Orders Form, with an arrow showing where to click to activate the drop-down list. The recorded commentary could explain such things as restrictions or surcharges on certain payment methods. Our example also has help categories for General Data Entry, Items Ordered, and Terms. Since this help system can be activated from anywhere in an application, it could also include help for other forms or tables.

Create a database called HELP.DB to store your help images. Its first field should be a keyed numeric field named Number, which will determine the order of the images. The second field should be an alphanumeric field named Topic. Follow these with a graphic field named Help Picture and an alphanumeric field named Sound File. Create a secondary index called TopicOrder, selecting Topic as the indexed field.

Now create the records for the database. Enter the Topic names as you want them to appear in your menu. In the Number field, use a decimal point to distinguish the ordering of the topics from the ordering of each image within a topic. For example, our three General Data

Entry records are numbered 1.1, 1.2, and 1.3, and our two Items Ordered records are numbered 2.1 and 2.2. Give your introductory screen the number 0.1 and the topic Welcome. Our Talking Help includes a tutorial mode that will automatically play through all the topics in the order you've created. Paste each of your graphics into the Help Picture field of the appropriate record and type the name of each accompanying .WAV file into Sound File.

To display the Talking Help as shown in Figures 2 and 3, we'll create a form called HELP.FSL for this database. Place

Enhance your Windows database program with a custom audiovisual help system that uses the sound board to provide spoken instructions.

the Help Picture field on the form and size it to accommodate your graphics. Then place the Sound File field on the form and deselect its Visible value (right-click on the field, click on Run Time, then on Visible).

Create any visual enhancements you'd like (we've added a blue background, the

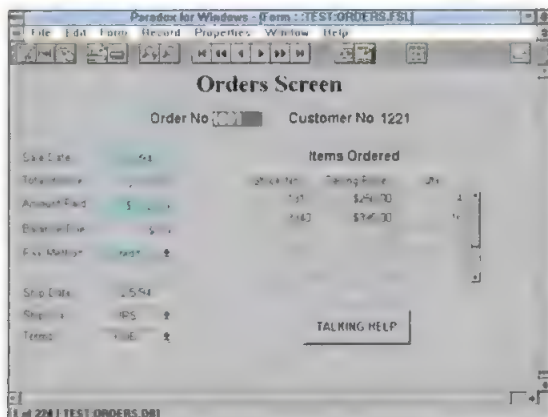


Figure 1: This sample Orders Form is elucidated by a Talking Help system.

heading Order Entry Help, and a gray box to contain the buttons). Then use the Button Tool to add five buttons, labeling them as in Figure 2. The Previous and Next buttons will let the user move through the screens. If the Auto button is engaged, the screens will advance automatically. Topics will call up a menu, and Exit will close the form.

Make the Auto button a check box by right-clicking on it and selecting Button Type, then Check Box. Rename the first four buttons PreviousButton, NextButton, AutoButton, and TopicsButton. Change the names of the labels on PreviousButton and NextButton to Label. (You change an object's name in Paradox by selecting the object, right-clicking on it, clicking on the default name at the top of the pop-up menu, and typing in the new object name.)

ADDING THE CODE Now we'll use ObjectPAL to make our help form functional. First we need to declare the Windows API function `sndPlaySound()`, which will let Paradox access Windows' built-in wave audio capabilities. With your form in Design Mode, select Properties, then Form, then Methods from the menus. Check the Uses box and click OK. In the editing window, edit the default text so that it looks like this:

```
Uses MMSYSTEM
    sndPlaySound(lpszSoundName CPtr,
        wFlags CWORD) CWORD
endUses
```

If you're working with a Windows database other than Paradox, you should still be able to use `sndPlaySound()` if the database's programming language supports calls to DLLs. Follow the language's syntax to declare the function (which is contained in `MMSYSTEM.DLL`) and its parameters properly, replacing `CPtr` and `CWORD` with the language's keywords for string and integer data types, respectively.

Now you can use the `sndPlaySound()` function in your form just like a built-in ObjectPAL method. It takes two parameters—the name of a .WAV file to play and an integer value that determines how

the file is played.

To play the sounds, we'll attach code (Figure 4) to the Arrive method of the Help Picture field, so the code will execute whenever a new record is displayed, launching the .WAV file named in Sound File. This code also disables PreviousButton and NextButton when appropriate. Right-click on Help_Picture, select Methods, and double-click on Arrive. In the edit window, insert the code in Figure 4 after the first line of default code. (You can download all code mentioned in this article from PC MagNet's Programming Forum archived as AVHELP.ZIP.)

We've used an If statement here to execute `sndPlaySound()` only if the form is visible. This is necessary because the form will be hidden when it is first loaded and then made visible to give a cleaner display. Without this If statement, `sndPlaySound()` would execute several times in quick succession, creating a stutter. If your .WAV files are not in the working directory, alter the pathname used here in `sndPlaySound()`. (Note that ObjectPAL requires double backslashes in directory names.)

The `atFirst()` and `atLast()` methods check to see if the current record is the first or the last in the database. The code grays out the label of PreviousButton at the first record and grays out NextButton at the last record, making navigation easier.

Now we'll make the buttons functional. First we'll add code to the pushButton Method of PreviousButton. Right-click on the button, select Methods, double-click on pushButton, then insert the command `Help_Picture.priorRecord()` after the first line of default code. In similar fashion, add the command `Help_Picture.nextRecord()` to the pushButton Method of NextButton. To disable the buttons whenever their labels are grayed out, add the following code to the mouse-Down Method of both these buttons:

```
if Label.Font.Color = DarkGray then
    disableDefault
endif
```

Add these two lines to the pushButton Method of the Exit button:

```
sndPlaySound("", 4)
close()
```

When `sndPlaySound()` is called with the parameters shown above, it terminates



Figure 2: This is the introductory screen of the Talking Help system, showing the help menu.

any .WAV file currently playing.

NONSTOP TALK Now we'll enable Talking Help to advance its help screens automatically. This involves playing sound files in succession, a process that is more complex than it may at first seem. We've used `sndPlaySound()` in the Arrive Method of Help_Picture with its second



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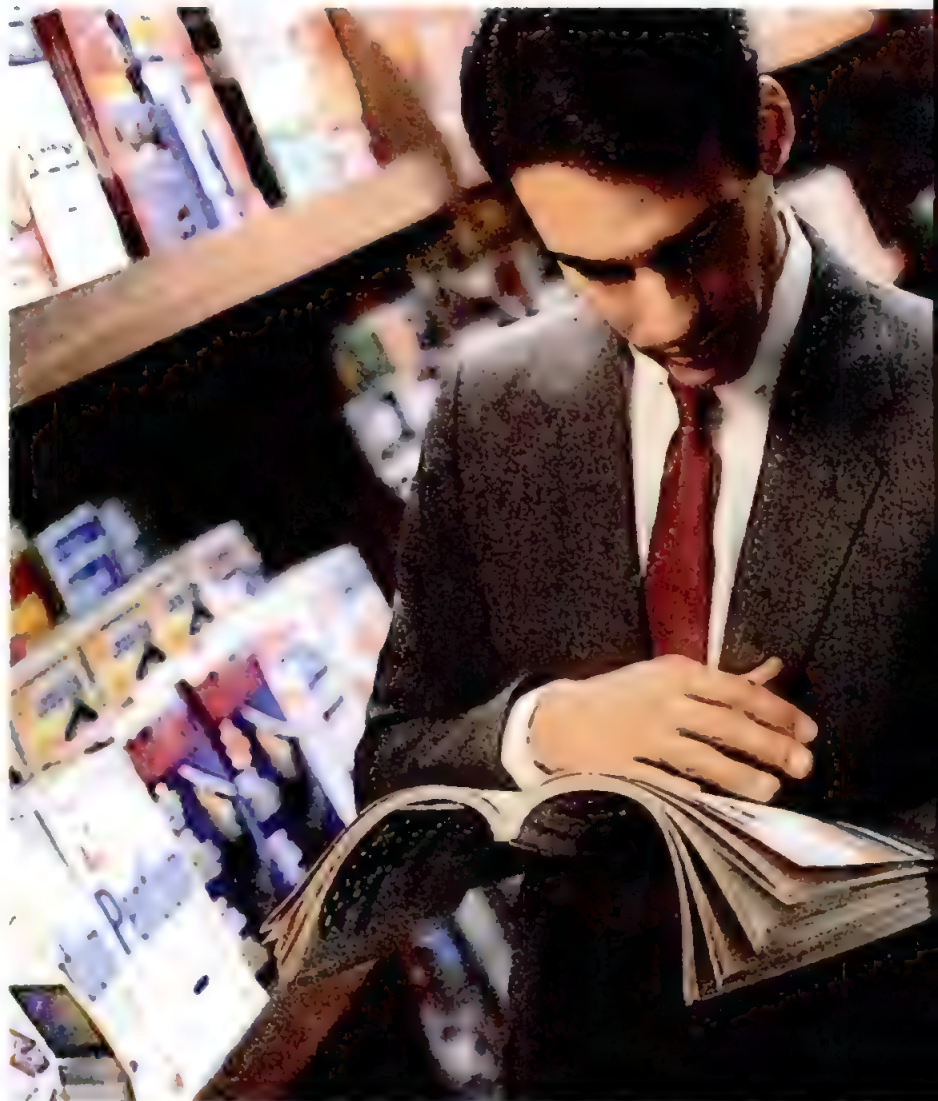
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parameter set to 1 for asynchronous execution. This means the sound plays in the background while other processing continues. If two asynchronous `sndPlaySound()` functions follow each other in succession, the second will curtail the first before it has had a chance to play.

Alternatively, you can execute `sndPlaySound()` synchronously, so that all other processing halts while the sound is playing. This lets the program play sound files one after another, but the system is frozen while the sounds are playing. This precludes the user from activating the navigation or Exit buttons until the sound stops.

To solve this problem, we'll use `sndPlaySound()` merely to check whether a sound is currently playing, which it will indicate by returning either 1 or 0. To do this, we'll use the function with the parameters "" and 17. The second parameter consists of the sum of two bit flags, 1 and 16. The 1 tells `sndPlaySound()` to play a sound asynchronously, while the 16 tells it not to terminate any currently playing sound. If `sndPlaySound()` is called with these parameters while a .WAV file is playing, the function returns a value of 0, indicating that it couldn't play a new sound. If no .WAV file is playing, the function "plays" the null sound indicated by the empty first parameter and returns 1, indicating that the function played its sound successfully.

To detect the moment the sound stops

playing, `sndPlaySound()` must be executed repeatedly, a process called polling. We can use Paradox's Timer Method to perform this polling and then respond by playing the next sound when the value re-

```
var
    helpForm Form
endVar
helpForm.attach()
if helpForm.isVisible() then
    sndPlaySound("c:\pdxwin\working\" +
        StrVal(Sound_File), 1)
endIf
if self.atFirst() = True then
    PreviousButton.Label.Font.Color = DarkGray
else PreviousButton.Label.Font.Color = Black
endIf
if self.atLast() = True then
    NextButton.Label.Font.Color = DarkGray
else NextButton.Label.Font.Color = Black
endIf
```



Figure 4: Attaching this code to the Arrive method of the Help Picture field means the code will execute whenever a new record is displayed, launching the .WAV file named in Sound File.

turned is 1. Add the following code to the Timer Method of AutoButton:

```
if Help_Picture.atLast() = False then
    if sndPlaySound("", 17) = 1 then
        Help_Picture.nextRecord()
    endIf
endIf
```

Add this to the pushButton Method of the same button:

```
if self.value = False then
    self.setTimer(100)
else self.killTimer()
endIf
```

Now whenever AutoButton is engaged or disengaged, it will use the `setTimer()` or `killTimer()` methods to turn its timer on or off. When activated, the timer executes the code in the Timer Method every 100 milliseconds. Whenever `sndPlaySound()` returns 1, the next record is displayed—unless the last record has already been reached.

Now we'll attach code to TopicsButton to display the pop-up menu shown in Figure 2. When the user selects a topic, our program will filter out all the records that don't match the selection.

First we need to define some variables. Open the button's Methods dialog box, check Var, and click OK. Insert this after the first line of default code:

```
helpMenu PopUpMenu
helpTC TCursor
```

The code to create the menu goes in the Open Method of TopicsButton, where it's executed only the first time the button is pushed. Here's the code we've used for our example:

```
helpTC.open("help.db")
helpMenu.addText("General Data Entry")
helpMenu.addText("Items Ordered")
helpMenu.addText("Payment Method")
helpMenu.addText("Terms")
helpMenu.addSeparator()
helpMenu.addText("Tutorial")
```

The first line opens a pointer to the Help database to facilitate sorting and filtering its records. (If your HELP.DB database isn't in the Paradox working directory, you'll need to include the full pathname in the parameter of this command.) The `addText()` Method creates the options for the menu. Be sure the topic names you use here are identical to those stored in the Topics field of the database.

Add the code in Figure 5 to the pushButton Method of TopicsButton to display the menu and process the selection. The `setMouseScreenPosition()` function moves the cursor to position the menu near the middle of the screen (you may have to adjust the method's two numeric parameters, which determine the x and y coordinates). The next line displays the menu and stores the selection in the variable `selection`.

If Tutorial is selected, the `setFilter()` Method selects all the records numbered from 1.0 to 5.0 (filtering out the opening Welcome screen), and the AutoButton is engaged. If another option is selected, `switchIndex()` applies the secondary index so that `setFilter()` can then select only those records in which the Topic value matches the user's menu selection. Using the `helpTC` pointer and `resync()` Method prevents the indexing and filtering from disrupting the display.

MAKING IT CONTEXT-SENSITIVE Now we'll go to the Orders Form and implement the code to display the Help Form.

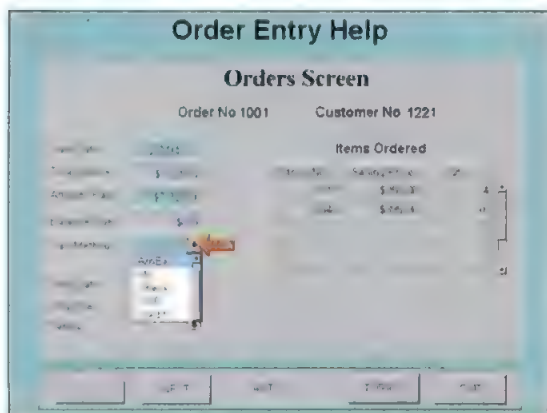


Figure 3: This help screen provides assistance for the Payment Method field of the example sample Orders Form.



The program will be context-sensitive, displaying a help topic appropriate to the user's current position in the Orders Form. First declare `sndPlaySound()` in the Orders Form, just as you did in the Help Form. Next, create a new custom method by selecting Properties, then Form, then Methods from the menus, typing `displayHelp` in the New Custom Method field and clicking OK. Add the code shown in Figure 6 to the new method, modifying it where necessary to suit your application.

The sixth line in Figure 6 ascertains which field the cursor is on and stores the fieldname in the variable *context*. The next line opens *HELP.FSL*

as a maximized dialog box but keeps it hidden for a cleaner display (remember to include the pathname if the form isn't in the WORKING directory). The switch structure determines the appropriate Topic name to use as a record selection filter, depending on the value of *context*. The show() function displays the form and sndPlaySound() plays the first .WAV file (again, remember to change the pathname if necessary).

If the current field of the Orders Form doesn't correspond to a help topic, the program displays the opening Welcome screen and then runs the code attached to TopicsButton on the Help Form to display the help menu.

To launch `displayHelp()` from a `pushbutton`, as we've done in our example (see the button labeled TALKING HELP in Figure 1), merely place a button on your form and add the command `displayHelp()` to its `pushButton`

Method. Alternatively, you could launch the method from a pull-down menu or a function key.

You can launch Talking Help from any other form in your application merely by adding the code given above to the form, modifying it where necessary to



Figure 6: This code displays a help topic appropriate to the user's current position in the Orders Form.

suit your application. The techniques that I have discussed in this column could also be used to create other kinds of talking databases—for example, a database of products that you can browse by means of pictures and audio descriptions of each item. □

ROBERT KENDALL IS A FREELANCE WRITER, MULTIMEDIA DEVELOPER, AND FREQUENT CONTRIBUTOR TO PC MAGAZINE.

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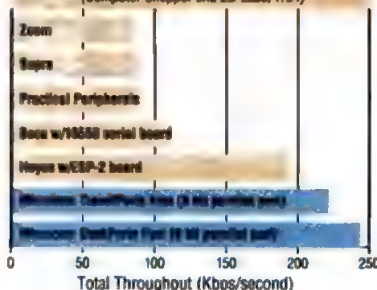
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Modem Performance in Windows
(Computer Shopper and ZD Labs, 7/94)



The problem with ordinary modems is the serial port bottleneck. At high speeds, Windows data slams on the brakes as it tries to squeeze through your modem's **serial port—which can only transfer data one bit at a time**. Results: slower performance, frequent loss of data and higher phone charges.

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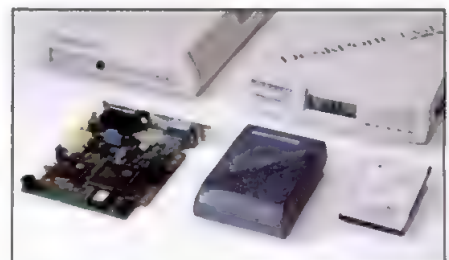
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CIRCLE 862 ON READER SERVICE CARD

Toolkits

BY REX CONN

WindowsMaker: Visual Design

Developing a C or C++ application for Microsoft Windows is still much more difficult than it ought to be. Blue Sky Software's WindowsMaker Professional, Version 5.5 (\$995), goes a long way towards making C and C++ programming for Windows as simple as it is in Microsoft Visual Basic. WindowsMaker supports Win16 (Windows and Windows for Workgroups), Win32s, and Win32 code generation.

The generated code can be compatible with ANSI C, MFC (Microsoft Foundation Classes for C++), or Borland's OWL (Object Windows Library for C++). You can switch among languages and libraries at any time during development. (A stripped-down version of WindowsMaker is integrated into Symantec C++.)

A VISUAL SCREEN DESIGNER WindowsMaker's Visual Screen Designer works much like AppStudio or Resource Work-

shop. You create the user interface with the usual point-and-click and drag-and-drop. The difference is that Visual Screen Designer lets you immediately attach simple functionality to interface controls without writing any code. When a button or a menu item is selected, you can play a .WAV or .AVI file, pop up a dialog box, invoke WinHelp, run an external application, change the menu bar, or add a toolbar. Multimedia support (the ability to play .WAV and .AVI files) is new with Version 5.5.

You can get a head start on designing a Windows application by using the 15 application templates, each of which defines a set of standard menus, toolbars, status bars, and dialogs. You can create single document or MDI (multiple document interface) applications. An invaluable "Preview Mode" lets you test the application without first having to compile and link it. Everything in the application can be tested except for user-written code. You can

even edit while in Preview Mode and continue testing with the changes.

Another useful feature is the ability to capture menus and dialogs from other programs. Run the other application, choose the "Capture Dialog Box" option from WindowsMaker, then double-click on the application's dialog box. WindowsMaker will capture the dialog box and start the Visual Screen Designer so you can incorporate it into your program.

To go beyond the user interface and simple functionality, you'll need to add your own code. Simply double-click on the control (just as in Visual Basic) and WindowsMaker will pop up an edit window. As long as you segregate your code in separate "usercode" modules, it won't be overwritten when the WindowsMaker code generator is invoked.

Don't expect to dive into WindowsMaker without looking at the manual or tutorials. WindowsMaker dialog boxes are occasionally cryptic and nested deeply and confusingly. Becoming familiar with the toolkit's capabilities will take a few hours. The printed documentation has a few misleading parts (it's a holdover from Version 5.0), but the on-line help is accurate, extensive, and clearly written.

At the time of this review, WindowsMaker did not include OLE 2.0 support. The company says it is in the works and may be included in Version 6.0, which is scheduled for release by the end of this year. Version 6.0 will contain a variety of other enhancements as well, including support for Visual Basic custom controls.

Though its price and learning curve are somewhat high, WindowsMaker will enhance your productivity and improve the quality of your code. WindowsMaker works flawlessly, and the code it generates is well written and documented—worth studying for Windows programming insights. We recommend WindowsMaker for any serious Windows developer.

► **WindowsMaker Professional, Version 5.5.** List price: \$995. Requires: 12MB hard disk space; Microsoft Windows 3.x or Windows NT; any ANSI-, MFC-, or OWL-compliant C compiler. Blue Sky Software Corp., 7486 La Jolla Blvd., #3, La Jolla, CA 92037; 800-677-4946, 619-459-6365; fax, 619-459-6366; BBS, 619-551-2495.

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OFF THE STACK

● Asymmetrix Corp.'s InfoModeler is a database design tool that enables professional database developers to design systems much more quickly and accurately. InfoModeler uses FORML technology to help end users and systems analysts communicate more clearly; it works with Microsoft Access, Microsoft FoxPro, Oracle7, Paradox for Windows, and SQL Server, Version 4.2. The desktop edition costs \$795; the client/server editions (Oracle7 and SQL Server) cost \$1,495 each. Asymmetrix Corp.; 800-448-6543.

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● Robust Software has released Version 1.5 of its CodeLock copy protection software for Microsoft Windows. CodeLock uses software to provide the security of a hardware lock. Users are forced to register the software they acquire through a telecommunications process. Three types of locks are available: a program lock that prevents copying, a time lock that sets the number of days the program will run, and a counter lock that sets how many times the software will run. The price is \$399 for up to 250 registered users, \$699 for up to 1,000 users. Robust Software; 805-688-6312.

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Environments

BY CHARLES PETZOLD

Metafiles, Mapping Modes, and Transforms

In the olden (and largely academic) days of computer-graphics theory, it was assumed that display surfaces were continuously addressable. There were no such nuisances as pixels to impose limitations on the coordinate addressability of the device. Indeed, early video displays were vector devices rather than the raster devices used today. The electron beam could be moved in any type of pattern instead of being confined to sweeps of horizontal lines. (There was a good reason for this: Raster displays require more memory than vector displays, and memory was quite expensive back then.) Nowadays, the only continuously addressable graphics display device commonly used is the pen plotter, and plotters are quickly becoming obsolete with the widespread availability of inexpensive color laser printers.

The background of those early theoreticians of computer graphics was often mathematics, so they tended to think of the display as a hardware implementation of a rectangular (or Cartesian) coordinate system. The origin would be in the center of the display, and coordinates would extend for (say) 1,000 units horizontally left and right and vertically up and down. Of course, nothing prevented you from using fractional coordinates.

These days, real-world displays are almost always raster devices. Video displays and laser printers have a discrete pixel resolution that constrains the addressability.

TO MAP OR NOT TO MAP Windows is primarily a pixel-based graphics system. And because there is no such thing as a

fractional pixel, Windows could be an integer-based system. For programmers who preferred to work in arbitrary units, or the metric units of inches or millimeters, the early designers of the Windows Graphical Device Interface (GDI) introduced the concept of the mapping mode.

The mapping mode is simply a coordinate transform that involves translation and scaling. For example, when you select the mapping mode of `MM_LOENGLISH` (which lets you draw in units of 0.01 inches), GDI sets up a scaling factor that is effectively the number of pixels in 0.01 inches for the particular device. (This is expressed as a ratio of two integers to avoid floating-point calculations.)

Certainly, using mapping modes is convenient in some cases. But as I've often demonstrated, it is possible to work in units of inches or millimeters without using mapping modes. The `GetDeviceCaps` function gives you all the information you need to do your own scaling properly.

Obviously, I'm not privy to the source code of large graphical applications, but I suspect that most programmers of those applications tend to avoid the mapping modes or to use them sparingly. After all, letting GDI do coordinate scaling involves relinquishing some control. Many programmers don't like to do that.

Also, once a programmer encounters a

problem with mapping modes, the ease-of-use issue becomes irrelevant. One such problem involves the `ScrollDC` function, which scrolls an area of the device context. The `ScrollDC` function requires device units (pixels). If you're using a mapping mode when drawing, you must use the `LPtoDP` function to convert the logical units of the scroll area to device units in preparation for calling `ScrollDC`. Sometimes this results in annoying off-by-one rounding errors.

I'm not advocating that you forgo mapping modes, of course, or (worse) avoid learning about them because you believe you'll never use them. A good graphics programmer knows the entire graphics system—particularly, how various functions interact—and uses whatever is appropriate for the job.

METAFILES, INCHES, AND MILLIMETERS

In the past several columns, I've been discussing the enhanced metafile format as implemented under Windows NT. In the previous column, I showed you how to encode the image of a 6-inch ruler in a metafile and then display it in its proper

size on both the video display and the printer. Both steps of this job involved working with dimensions other than pixels, although I managed to avoid using mapping modes. When creating the metafile, it was necessary to use `GetDeviceCaps` to find the number of pixels per inch based

on the video display. Thus, the ruler could be drawn in the metafile device context using pixels.

As we've seen, GDI encodes two pieces of important information in the header section of the enhanced metafile. These are the rectangular bounding box of the image in pixels and also in units of 0.01 millimeters. The relationship between these two rectangles is based on the resolution of the reference device context, which by default is the video display.

To display the metafile image in its proper size, you use the rectangle stored in the header that provides the bounding box in units of 0.01 millimeters. Based on the resolution of the device on which you're

A good graphics programmer knows the entire graphics system and uses whatever is appropriate for the job.


```

/*-----
EMF12.C -- Enhanced Metafile Demo #12
(c) Charles Petzold, 1994
-----*/

#include <windows.h>
#include <string.h>

char szClass [] = "EMF12" ;
char szTitle [] = "EMF12: Enhanced Metafile Demo #12" ;

void DrawRuler (HDC hdc, int cx, int cy)
{
    char    ch ;
    HFONT    hFont ;
    int    i, iHeight ;
    LOGFONT lf ;

    Rectangle (hdc, 0, 0, cx + 1, cy + 1) ;

    for (i = 0 ; i < 96 ; i++)
    {
        if (i % 16 == 0) iHeight = cy / 2 ;    // inches
        else if (i % 8 == 0) iHeight = cy / 3 ;    // half inches
        else if (i % 4 == 0) iHeight = cy / 5 ;    // quarter inches
        else if (i % 2 == 0) iHeight = cy / 8 ;    // eighths
        else iHeight = cy / 12 ;    // sixteenths

        MoveToEx (hdc, i * cx / 96, 0, NULL) ;
        LineTo (hdc, i * cx / 96, iHeight) ;
    }

    memset (&lf, 0, sizeof (lf)) ;

    lf.lfHeight = cy / 2 ;

    strcpy (lf.lfFaceName, "Times New Roman") ;

    hFont = CreateFontIndirect (&lf) ;

    SelectObject (hdc, hFont) ;
    SetTextAlign (hdc, TA_BOTTOM | TA_CENTER) ;
    SetBkMode (hdc, TRANSPARENT) ;

    for (i = 1 ; i <= 5 ; i++)
    {
        ch = (char) (i + '0') ;

        TextOut (hdc, i * cx / 6, cy / 2, &ch, 1) ;
    }

    SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
    DeleteObject (hFont) ;
}

void CreateRoutine (HWND hwnd)
{
    HDC    hdcEMF ;
    HENHMETAFILE hemf ;

    hdcEMF = CreateEnhMetaFile (NULL, "emf12.emf", NULL,
                                "EMF12\\EMF Demo #12\\0") ;

    SetMapMode (hdcEMF, MM_LOENGLISH) ;

    DrawRuler (hdcEMF, 600, 100) ;

    hemf = CloseEnhMetaFile (hdcEMF) ;

    DeleteEnhMetaFile (hemf) ;
}

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
{
    ENHMETAHEADER emh ;
    HENHMETAFILE hemf ;
    int    cxMms, cyMms, cxPix, cyPix, cxImage, cyImage ;
    RECT    rect ;

    cxMms = GetDeviceCaps (hdc, HORZSIZE) ;
    cyMms = GetDeviceCaps (hdc, VERTSIZE) ;
    cxPix = GetDeviceCaps (hdc, HORZRES) ;
    cyPix = GetDeviceCaps (hdc, VERTRES) ;

    hemf = GetEnhMetaFile ("emf12.emf") ;

    GetEnhMetaFileHeader (hemf, sizeof (emh), &emh) ;

    cxImage = emh.rc1Frame.right - emh.rc1Frame.left ;
    cyImage = emh.rc1Frame.bottom - emh.rc1Frame.top ;

    cxImage = cxImage * cxPix / cxMms / 100 ;
    cyImage = cyImage * cyPix / cyMms / 100 ;

    rect.left = (cxArea - cxImage) / 2 ;
    rect.top = (cyArea - cyImage) / 2 ;
    rect.right = (cxArea + cxImage) / 2 ;
    rect.bottom = (cyArea + cyImage) / 2 ;

    PlayEnhMetaFile (hdc, hemf, &rect) ;
    DeleteEnhMetaFile (hemf) ;
}

```



Figure 1: The EMF12.C file encodes a ruler into a metafile using a mapping mode.

drawing the metafile, you convert the dimensions of the image to pixels. This provides the information you need to set up a destination rectangle for the PlayEnhMetaFile call. The metafile image is displayed within that destination rectangle.

I avoided using mapping modes in the previous issue's sample programs because I wanted as little as possible happening behind the scenes. But the question naturally arises: Can we use mapping modes to simplify the creation and display of metafiles? Well, let's try.

EMBEDDED SETMAPMODE FUNCTIONS

When you call SetMapMode using a metafile device context, the function is encoded in the metafile just like any other GDI function. This is demonstrated in the EMF12 program shown in Figure 1. You'll need the EMF files from the previous column to compile and link this program. If you have Windows NT and the Win32 Software Development Kit installed, you can create EMF12.EXE by running `NMAKE EMF12.MAK` from a Windows NT command line. Or you can

download the executable and all the sources files from PC MagNet's Programming Forum, archived as EMF12.ZIP.

The CreateRoutine function in EMF12 is simpler than the one in EMF9 (our original ruler-metafile program) because it does not need to call GetDeviceCaps to determine the resolution of the video display in dots per inch. Instead, EMF12 calls SetMapMode to set the mapping mode to MM_LOENGLISH, where logical units are equal to 0.01 inches. Thus, the dimensions of the ruler are 600 units by 100 units, and these numbers are passed to the DrawRuler function.

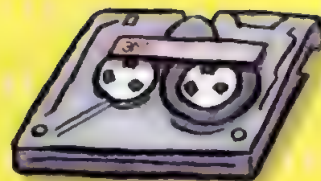
The DrawRuler function in EMF12 is the same as the one in EMF9, except for the MoveToEx and LineTo calls that draw the tick marks of the ruler. When drawing in units of pixels (the default MM_TEXT mapping mode), units on the vertical axis increase going down the screen. For the MM_LOENGLISH mapping mode (and the other metrical mapping modes), units increase going up. That required a change to this code.

The PaintRoutine function in EMF12 is basically the same as the one in the previous issue's EMF10, which was the version of the program that successfully displayed the ruler in its correct dimensions on both the video display and the printer. The only difference is that EMF12 uses the EMF12.EMF file, whereas EMF10 used the EMF9.EMF file created by EMF9.

In the header record of EMF9.EMF, the dimensions were recorded as 402 pixels wide and 67 pixels high and 150.75 millimeters wide and 25.13 millimeters high. Of course, there are 25.4 millimeters to the inch, so the dimensions are not precise. This results from the program rounding the VGA pixel resolution to 67 dots per inch. I mentioned earlier that the dimensions of the image are recorded as rectangles. For EMF9, the left and top fields of the RECT structure are zero; these figures indicate the right and bottom fields.

In EMF12.EMF, the RECT structure fields for the pixel dimensions are recorded as (0, -67, 406, 0), and the millimeter dimensions are (0, -25.49, 152.25, 0). This

The path to follow whichever storage option you choose.

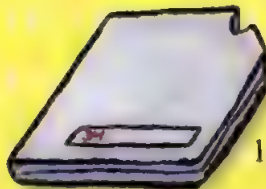


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1/2" Tape Cartridge



2 GB-4mm
Data Tape



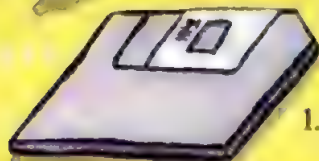
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```

/*-----
EMF13.C -- Enhanced Metafile Demo #13
(c) Charles Petzold, 1994
-----*/

#include <windows.h>
#include <string.h>

char szClass [] = "EMF13" ;
char szTitle [] = "EMF13: Enhanced Metafile Demo #13" ;

void DrawRuler (HDC hdc, int cx, int cy)
{
    char    ch ;
    HFONT    hFont ;
    int      i, iHeight ;
    LOGFONT lf ;

    Rectangle (hdc, 0, 0, cx + 1, cy + 1) ;

    for (i = 0 ; i < 96 ; i++)
    {
        if (i % 16 == 0) iHeight = cy / 2 ;    // inches
        else if (i % 8 == 0) iHeight = cy / 3 ;    // half inches
        else if (i % 4 == 0) iHeight = cy / 5 ;    // quarter inches
        else if (i % 2 == 0) iHeight = cy / 8 ;    // eighths
        else             iHeight = cy / 12 ;    // sixteenths

        MoveToEx (hdc, i * cx / 96, cy, NULL) ;
        LineTo   (hdc, i * cx / 96, cy - iHeight) ;
    }

    memset (&lf, 0, sizeof (lf)) ;
    lf.lfHeight = cy / 2 ;

    strcpy (lf.lfFaceName, "Times New Roman") ;

    hFont = CreateFontIndirect (&lf) ;

    SelectObject (hdc, hFont) ;
    SetTextAlign (hdc, TA_BOTTOM | TA_CENTER) ;
    SetBkMode    (hdc, TRANSPARENT) ;

    for (i = 1 ; i <= 5 ; i++)
    {
        ch = (char) (i + '0') ;

        TextOut (hdc, i * cx / 6, cy / 2, &ch, 1) ;
    }

    SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
    DeleteObject (hFont) ;
}

void CreateRoutine (HWND hwnd)

```

```

{
    HDC          hdcEMF ;
    HENHMETAFILE hemf ;
    int          cxMms, cyMms, cxPix, cyPix, xDpi, yDpi ;

    hdcEMF = CreateEnhMetaFile (NULL, "emf13.emf", NULL,
                                "EMF13\\EMF Demo #13\\0") ;

    cxMms = GetDeviceCaps (hdcEMF, HORZSIZE) ;
    cyMms = GetDeviceCaps (hdcEMF, VERTSIZE) ;
    cxPix = GetDeviceCaps (hdcEMF, HORZRES) ;
    cyPix = GetDeviceCaps (hdcEMF, VERTRES) ;

    xDpi = cxPix * 254 / cxMms / 10 ;
    yDpi = cyPix * 254 / cyMms / 10 ;

    DrawRuler (hdcEMF, 6 * xDpi, yDpi) ;

    hemf = CloseEnhMetaFile (hdcEMF) ;

    DeleteEnhMetaFile (hemf) ;
}

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
{
    ENHMETAHEADER emh ;
    HENHMETAFILE hemf ;
    POINT          pt ;
    int            cxImage, cyImage ;
    RECT           rect ;

    SetMapMode (hdc, MM_HIMETRIC) ;

    SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

    pt.x = cxArea ;
    pt.y = 0 ;

    DPTOLP (hdc, &pt, 1) ;

    hemf = GetEnhMetaFile ("emf13.emf") ;

    GetEnhMetaFileHeader (hemf, sizeof (emh), &emh) ;

    cxImage = emh.rc1Frame.right - emh.rc1Frame.left ;
    cyImage = emh.rc1Frame.bottom - emh.rc1Frame.top ;

    rect.left  = (pt.x - cxImage) / 2 ;
    rect.top   = (pt.y + cyImage) / 2 ;
    rect.right = (pt.x + cxImage) / 2 ;
    rect.bottom = (pt.y - cyImage) / 2 ;

    PlayEnhMetaFile (hdc, hemf, &rect) ;
    DeleteEnhMetaFile (hemf) ;
}

```

Figure 2: The EMF13.C file displays a ruler metafile using a mapping mode.

accounts for units of y increasing going up. Also, note that GDI managed to be a bit more accurate in calculating the dimensions of the ruler. Because EMF12 calculates the horizontal and vertical dimensions of the image by subtracting the left field from the right field, and the top field from the bottom field, the calculation yields the same result as EMF10.

The image displayed by EMF12 is ba-

sically the same as EMF10. So we see here how embedding a SetMapMode call into a metafile can simplify the metafile creation and doesn't affect at all the mechanics of playing the metafile in its correct size. Now, let's see what other games we can play.

MAPPING AND PLAYING Calculating the destination rectangle in EMF12 involves some calls to GetDeviceCaps. Our

second goal is to eliminate those and use a mapping mode instead. GDI treats the coordinates of the destination rectangle as logical coordinates. Using the MM_HIMETRIC mode seems like a good idea for these coordinates, because that makes logical units 0.01 millimeters, the same units used for the bounding rectangle in the enhanced metafile header.

The EMF13 program shown in Figure

```

/*-----
EMF14.C -- Enhanced Metafile Demo #14
(c) Charles Petzold, 1994
-----*/

#include <windows.h>

char szClass [] = "EMF14" ;
char szTitle [] = "EMF14: Enhanced Metafile Demo #14" ;

void CreateRoutine (HWND hwnd)
{
}

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
{
    ENHMETAHEADER emh ;
    HENHMETAFILE hemf ;
    POINT          pt ;
    int            cxImage, cyImage ;
    RECT           rect ;

    SetMapMode (hdc, MM_HIMETRIC) ;

```

```

    SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

    pt.x = cxArea ;
    pt.y = 0 ;

    DPTOLP (hdc, &pt, 1) ;

    hemf = GetEnhMetaFile ("emf12.emf") ;

    GetEnhMetaFileHeader (hemf, sizeof (emh), &emh) ;

    cxImage = emh.rc1Frame.right - emh.rc1Frame.left ;
    cyImage = emh.rc1Frame.bottom - emh.rc1Frame.top ;

    rect.left  = (pt.x - cxImage) / 2 ;
    rect.top   = (pt.y + cyImage) / 2 ;
    rect.right = (pt.x + cxImage) / 2 ;
    rect.bottom = (pt.y - cyImage) / 2 ;

    PlayEnhMetaFile (hdc, hemf, &rect) ;

    DeleteEnhMetaFile (hemf) ;
}

```

Figure 3: The EMF14.C file displays the ruler metafile from EMF12 using a mapping mode.

```

/*-----
EMF15.C -- Enhanced Metafile Demo #15
(c) Charles Petzold, 1994
-----*/

#include <windows.h>
#include <math.h>

#define TWO_PI (2 * 3.14159)

char szClass [] = "EMF15" ;
char szTitle [] = "EMF15: Enhanced Metafile Demo #15" ;

void CreateRoutine (HWND hwnd)
{
}

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
{
    ENHMETAHEADER emh ;
    ENHMETAFILE hemf ;
    int cxImage, cyImage ;
    RECT rect ;
    XFORM xform ;

    SetMapMode (hdc, MM_HIMETRIC) ;

    SetViewportOrgEx (hdc, cxArea / 2, cyArea / 2, NULL) ;

    hemf = GetEnhMetaFile ("emf12.emf") ;
    GetEnhMetaFileHeader (hemf, sizeof (emh), &emh) ;

    cxImage = emh.rc1Frame.right - emh.rc1Frame.left ;
    cyImage = emh.rc1Frame.bottom - emh.rc1Frame.top ;

    rect.left = - cxImage / 2 ;
    rect.top = cyImage / 2 ;
    rect.right = cxImage / 2 ;
    rect.bottom = - cyImage / 2 ;

    SetGraphicsMode (hdc, GM_ADVANCED) ;

    xform.em11 = (FLOAT) cos (TWO_PI / 8) ;
    xform.em12 = (FLOAT) sin (TWO_PI / 8) ;
    xform.em21 = (FLOAT) -sin (TWO_PI / 8) ;
    xform.em22 = (FLOAT) cos (TWO_PI / 8) ;
    xform.eDx = (FLOAT) 0 ;
    xform.eDy = (FLOAT) 0 ;

    SetWorldTransform (hdc, &xform) ;

    PlayEnhMetaFile (hdc, hemf, &rect) ;

    DeleteEnhMetaFile (hemf) ;
}

```

Figure 4: The EMF15.C file displays the ruler metafile from EMF12 with rotation.

2 restores the original metafile-creation logic as presented in the previous issue's EMF9 but uses the MM_HIMETRIC mapping mode to display the metafile. The PaintRoutine function in EMF13 first sets the mapping mode to MM_HIMETRIC. As with the other metric modes, values of y increase going up the screen. However, the origin is still at the upper-left corner, which means that y coordinates within the client area are negative. To correct this oddity, the program calls SetViewportOrgEx to set the origin to the lower-left corner.

The device point (cxArea,0) is at the upper-right corner of the screen. Passing that point to the DPTOLP (device

the metafile, but the first call in the metafile changes the mapping mode to MM_LOENGLISH, so what does that do to the destination rectangle? But it actually works, as EMF14 (Figure 3) demonstrates. In this program, it's not necessary to create the ruler metafile using a mapping mode because it's already been created by EMF12. EMF14 simply loads that one and uses a mapping mode to calculate the destination rectangle, as with EMF13.

Now we can establish a couple of principles: When the metafile is created, GDI uses any embedded changes to the mapping mode to calculate the size of the metafile image in pixels and millimeters.

The size of the image is stored in the metafile header. When the metafile is played, GDI establishes the physical location of the destination rectangle based on the mapping mode in effect at the time of the PlayEnhMetaFile call. Nothing in the metafile can change that location.

THE WORLD TRANSFORM The enhanced metafile format is new with Windows NT, but so are a few other graphics features, such as the world transform. Logical points in NT are modified first by the world transform and then by the mapping mode (or, more accurately, the window and viewport origins and extents) to

yield device points. This implies that we can define a world transform in the destination device context and display the metafile image in a skewed or rotated rectangle. This is demonstrated in EMF15, shown in Figure 4.

To simplify the world-transform factors, I've set the origin to the center of the client area. This also eliminates the need for the DPTOLP call, because the destination-rectangle coordinates are positive and negative offsets (based on the size of the ruler) from the origin. The world-transform matrix rotates the destination rectangle 45 degrees counterclockwise around the origin. The results are shown in Figure 5.

Any mapping mode or world transform you set before the PlayEnhMetaFile call remains in effect after the call has completed. You'd probably expect such behavior. But how do other device-context attributes affect the metafile? For example, if you create a red pen and select it into the device context before calling PlayEnhMetaFile, will the ruler be drawn in red?

The answer is no. PlayEnhMetaFile effectively saves the state of the device context, sets the attributes to default values (which may be modified by commands within the metafile), and then restores the device-context state after completion. The only reason that the mapping mode and world transform affect the metafile is because GDI interprets the destination rectangle in the logical coordinates defined at the time PlayEnhMetaFile is called.

And now, let's end our exploration of the Windows NT enhanced-metafile format and move on to new pastures. □

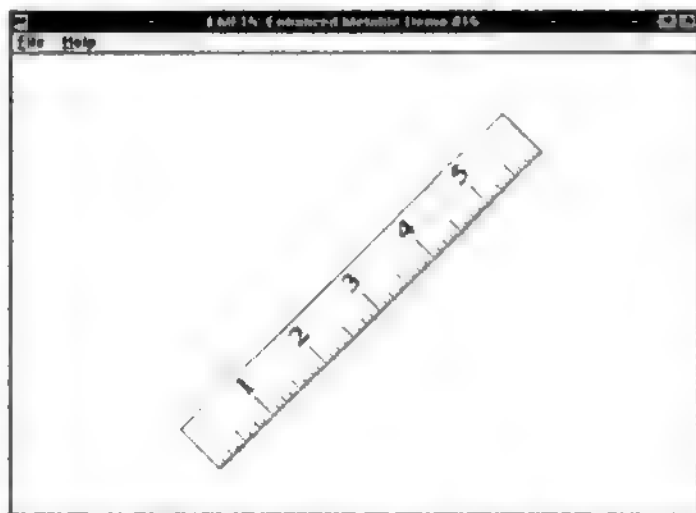


Figure 5: This is the rotated ruler that is displayed by the EMF15 program.

point to logical point) function gives us the size of the client area in 0.01 millimeters. The program then loads the metafile, gets the header, and finds the dimensions of the metafile in 0.01 millimeters. The destination rectangle centered in the middle of the client area is then easy to calculate.

COMBINING THE EFFECTS Now we've seen how we can use a mapping mode when creating the metafile and when displaying it. Can we do both? My immediate instinct told me "No way!" In effect, the program would be setting the mapping mode to MM_HIMETRIC when playing

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Power Programming

BY DAVID THIELEN

Real Games for Windows

The Microsoft Windows platform has taken over the desktop in all areas but one: games. Most games written for the PC are still DOS applications. This is because until recently Windows could not accomplish a block transfer (BLT—pronounced “blit”) of images quickly enough to deliver real-time animation.

Why was this capability left out of the initial design for Windows? To answer this we have to look at why Microsoft developed Windows. The most important reason was to offer an operating system that would be easier to use. But another reason, almost as important, was to provide a platform for the two key Microsoft applications, Excel and Word.

The Windows API (application programming interface) was designed to provide device drivers, text I/O, drawing primitives (for the charts in Excel), and device-dependent BLTs for drawing buttons. The only BLT in the Windows API was designed to draw a gray rectangle on a button face. Microsoft did not anticipate a need to BLT an image from memory to the screen.

Until about a year ago, the Windows device-driver advantage was less important for games than for a product like Word. Most games still have no need for printer drivers at all and can generally get by with just a few display drivers (Hercules, EGA, and VGA in most cases). And while developers of graphics-intensive games must focus on providing maximum performance, Windows (especially before Version 3.1) was not a platform that delivered performance. In short, Windows provided no important advantages to games programmers and at the same time entailed a large performance disadvantage.

.....

WINDOWS GAMES COME OF AGE This past year, changes have occurred that make Windows games more attractive. Most people now use Windows for everything but games, and they’ve come to expect applications to have the advantages of Windows. They don’t want to tell a game which sound and video card they’re using. Nor do they want to exit Windows to play a game. (After all, if you’re not running Windows, you can’t Alt-Tab from DOOM to Excel when your boss comes by.) And people most definitely don’t want games that require them to boot their systems differently.

Also, the Windows device-driver advantage has become more important for games. First, sound has become a must. Without Windows, this means developers must figure out how to program each sound card. In addition, there are now huge numbers of video cards, each kind requiring its own driver, and video-card companies often provide drivers only for Windows. DOS developers must do a lot of work to make their games support each video card.

Under Windows, the device-driver problem disappears. You can ship a game without device drivers, which means producing fewer disks and spending less time on development. And the game will run on virtually any machine. (Developers still have to test products on all types of

drivers. Some drivers follow the Windows specification a lot better than others. For example, the Diamond drivers map the palette incorrectly for brushes of non-active applications.)

Another advantage of Windows is its greater memory capacity. Windows provides almost 500MB of address space for each game. If that isn’t enough, you can write a Win32s game, giving you 4 gigabytes of address space (assuming there is enough RAM and disk space for the swap file). Also, the Windows programming environment provides easier access to this memory than you’d have using EMS or XMS memory under DOS. If you write your game using a DOS extender, you’ll find porting easy.

Perhaps the most important development is that Microsoft has finally addressed the performance problem. The fix is WinG—a set of ten additional API functions along with device drivers. WinG lets game developers BLT images to the screen as fast as they can under DOS.

WinG INNOVATIONS The way WinG works is through a new type of display device. Under Windows, anything can be a display device—not just video displays and printers. A display device is merely a driver that returns a device context (DC) and accepts calls to draw to that DC.

What makes the WinG display device different is that, unlike most other DCs, you can retrieve a pointer directly to the DC’s bitmap (which is always in DIB format) and its BITMAPINFOHEADER (including its palette table). This is what makes WinG so fast. Instead of making numerous Windows calls to draw in a DC, you directly access a DIB and then make a single Windows call to BLT the WinG DC contents to the screen. You can also use Windows GDI (Graphics Device Interface) calls on the WinG DC if you wish to draw text or use other GDI primitives.

These capabilities make all the difference. While you could usually get the pointer to the actual bits for a standard

WinG solves Windows' performance problem by letting game developers BLT images to the screen as fast as they can under DOS.

WinGDCs and WinGBitmap Functions

WinGCreateDC	Create a new WinGDC
WinGCreateBitmap	Create a new WinGBitmap
WinGGetDIBPointer	Return the DIB pointer to a WinGBitmap
WinGRecommendDIBFormat	Recommend an optimal DIB format for memory-to-screen blts
WinGGetDIBColorTable	Return the DIB color table of a selected WinGBitmap
WinGSetDIBColorTable	Set the DIB color table of a selected WinGBitmap

Bit-Blt Functions

WinGBitBlt	Copy a WinGDC to another DC
WinGStretchBlt	Copy a WinGDC to another DC with stretching

Halftoning Functions

WinGCreateHalftoneBrush	Create a halftone brush
WinGCreateHalftonePalette	Create a copy of the WinG halftone palette

Figure 1: WinG introduces ten new Windows API functions that let you BLT (block transfer) images from memory to the screen.

Windows HBITMAP, there were two problems with this approach. First, some video drivers would put the memory for a bitmap in video memory that was not addressable from the CPU. Second, and more critical, the format of the data in a standard HBITMAP is not defined; it differs from video driver to video driver. So even if you can access the data, you have no idea how the pixels are laid out.

When a WinG DC is first created, a 1-by-1 monochrome bitmap is attached to it. The next step is to create a WinG bitmap to attach to the WinG DC. But before we create a bitmap (in DIB format) to attach to our DC, we need to address one additional issue. A *DIB file* traditionally is a bottom-up bitmap (a legacy from OS/2), which means the order of the pixels in memory is as follows: the last row (left to right), then the second-to-last row, and so on until the first row. The memory on virtually every video card, however, is top-down.

WinG supports a radical new concept: top-down DIBs. Before you start cheering, however, there is a minor catch. For a given video card, WinG prefers that you supply either a bottom-up or top-down DIB, based on how the video card arranges its memory. And if you give it the other kind, your BLTs will be noticeably slower. So you need to use the DIB format WinG requests if you want to blast bitmaps up quickly.

If WinG does not recognize the video card it will request a bottom-up DIB, since it has to use the standard Windows

call WinGRecommendedDIBFormat to determine which format to supply for your DIB.

In calling WinGRecommendedDIBFormat, you should set the biBitCount parameter in the BITMAPINFOHEADER structure to 8. (WinG is presently optimized for 8-bit video; performance for higher pixel depths will not be as good.) However, while it is safe to assume that the BitCount will never be below 8, in the future it will probably return values of 16 and 24 for cards with higher color depth. So make sure you and WinG agree on the color depth you are working at: Set biBitCount to the color depth you desire.

The third step is to create a bitmap to attach to the DC. This is done with a call to WinGCreateBitmap, which creates a DIB to attach to the DC (returned as an HBITMAP) as well as a pointer to the DIB itself. The bitmap is then attached to the DC with a call to SelectObject. This method lets you create multiple WinG bitmaps and then select the one you need at any given time into the WinG DC.

You can also easily change the palette for the bitmap at any time. This is a two-step process. First you call WinGSetDIBColorTable to change the table in the WinG DIB. Second, you call the standard SelectPalette and RealizePalette before the next time you display the bitmap.

The last step is to BLT the image in the WinG bitmap to the screen. You can do this with one of two calls: WinGBitBlt or WinGStretchBlt. These calls perform the same function as the standard Windows

StretchDIBits. But if it recognizes the video card and the memory on the video card is top-down, WinG will request a top-down DIB. Virtually all video cards have top-down memory, so as WinG recognizes a larger and larger percentage of the video cards over the next couple of years, top-down DIBs should become prevalent. In the meantime, you must

BitBlt and StretchBlt calls, but the WinG versions BLT the images to the screen a lot faster.

If your palette will not change and you just want to create a single DIB to draw into and BLT to the screen, then the code in Figure 2 shows everything you have to do. In the interest of clarity, no error checking is shown in any of the code in this article, but please *do not* write your code this way. Also, the standard code for WM_DESTROY, WM_PALETTECHANGED, and WM_QUERYNEWPALETTE is not shown. (You can download all code mentioned in this column from PC MagNet's Programming Forum archived as BLT.ZIP.)

MULTIPLE BITMAPS If your palette changes or you want multiple bitmaps, then you need to do more. You weren't starting to think a feature in Windows was this easy, were you?

If your game has several different views, then it may pay to have a WinG bitmap for each view. To switch views, you can simply switch which bitmap is selected into the WinG DC by calling SelectObject. Or if your screen is divided into several rectangular panes, you can make each a separate DIB, select each into the DC, and BLT them. In both cases, you would create a single WinG DC and multiple bitmaps.

However, if you find that you are drawing each bitmap from scratch before you BLT it, there's no point in using multiple bitmaps. This may be the case if you are animating a single sprite on a background. In this case, a bitmap for the background and one twice the size of the sprite (so you can clear the old location on the same call if they overlap) makes a lot more sense.

In many cases, applications will use WinGCreateDC to create a single WinG DC and will use WinGCreateBitmap to create one or more WinGBitmaps that they will use to compose an image. The application will typically draw into this buffer using DIB copy operations, GDI calls, WinG calls, and custom drawing routines.

CHANGING THE PALETTE A more common situation occurs when your palette changes. Explaining the Windows palette could fill a book and is beyond the scope

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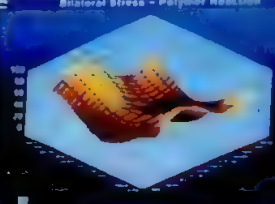


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Power Programming

of this article. A good reference is Ron Gery's article "The Palette Manager: How and Why" on the Microsoft Developer Network (MSDN) CD-ROM.

The system palette is the palette that Windows has set the video card to use. Under Windows, the palette of the active

palette—can GDI ignore the translation step. If you can skip this step, however, you will get a significant speed-up, since the translation code is called for every pixel. (This is true for non-WinG programs too.)

Under WinG, you still need to perform

```
case WM_CREATE :
gDC = WinGCreateDC ();
memset (&bmi, 0, sizeof (bmi));
bmi.hdr.biSize = sizeof (bmi);
WinGRecommendedDIBFormat (&bmi);
bmi.hdr.biBitCount = 8;
iDir = (int) bmi.hdr.biHeight;

// Setup your palette here
hPal = SelectPalette (...);
break;

case WM_SIZE : {
// note - a DIB width must be DWORD aligned
bmi.hdr.biWidth = (LOWORD (lParam) + 3) & ~3;
bmi.hdr.biHeight = HIWORD (lParam) * iDir;
// pDIB points to the WinG DIB on return
HBITMAP hbm = WinGCreateBitmap (gDC, &bmi, &pDIB);
// attach DIB to the DC
HBITMAP hPrevBm = (HBITMAP) SelectObject (gDC, hbm);
DeleteObject (hPrevBm);
break; }

case WM_PAINT : {
PAINTSTRUCT ps;
BeginPaint (hWnd, &ps);
SelectPalette (ps.hdc, hPal, FALSE); // set it to our palette
RealizePalette (ps.hdc);

...

WinGBitBlt (ps.hdc, ps.rcPaint.left, ps.rcPaint.top,
ps.rcPaint.right - ps.rcPaint.left,
ps.rcPaint.bottom - ps.rcPaint.top,
gDC, ps.rcPaint.left, ps.rcPaint.top);

EndPaint (hWnd, &ps);
return (0); }
```



Figure 2: If your palette doesn't change, this code fragment shows all you need to do to create a single DIB to draw into and BLT to the screen.

program gets first shot at the system palette. Windows matches palettes of other tasks to the foreground palette, first by filling up empty slots the active application did not use, and second, if there are no empty slots, by mapping the closest color.

If an application has a palette entry that exactly matches an existing entry in the system palette, unless you set the `peFlags` entry to `PC_RESERVED`, that entry will be mapped to the existing identical entry. This is done to avoid taking up two entries in the system palette with the same color. So, if color 123 in the new palette matches color 42 in the system palette, color 123 will be mapped to color 42.

The process of displaying a bitmap includes a step in GDI that translates the logical palette number in the DIB to the actual palette number in the system palette for each pixel. Only if there is no translation of any palette entry—if the system palette is identical to the logical

all the normal steps to change the palette. In addition, you need to use the `WinGSetColorTable` call to inform WinG that the palette for the bitmap has changed. You must make this call before you BLT the bitmap to the screen. If the palette changes several times before you BLT the bitmap, you only need to call `WinGSetColorTable` with the palette in use just before you BLT.

It is absolutely imperative under WinG that you use an *identity palette* (a palette with an exact one-to-one mapping of the entries in your DIB palette to the entries in the Windows system palette) for every bitmap you attach to a WinG DC. If even two palette entries are swapped (for instance, if palette index 5 in your DIB is palette index 6 in Windows and vice-versa), then your BLTs will take at least twice as long. The reason is that without an identity palette, every pixel you BLT must be converted from its palette index value in

the DIB to the value for the same color in the system palette. Don't screw this up.

There are two issues not covered sufficiently in Gery's article. First, to clear the system palette you must first initialize it with a set of RGB values. Any set will do as long as the `peFlags` variable is set to `PC_NOCOLLAPSE`. Otherwise, if there are empty entries in the palette, it will start at the first empty slot when you set your palette entries, fill up empty entries to the top, and then start at the bottom replacing existing entries. If this occurs, you will not obtain a one-to-one mapping and your game will run a lot slower.

Second, if there is the possibility that one of your colors is identical to one of the upper system colors, then when setting your palette, your colors must have `peFlags` set to `PC_RESERVED` instead of `PC_NOCOLLAPSE`. If you don't do this, the Windows palette manager will map the upper system color to your entry in the palette table and you will not have an identity palette.

You can only use `PC_NOCOLLAPSE` if you ensure at runtime that none of your palette colors match any of the upper ten system colors. Note that if you have hard-coded palette colors, it's not good enough to test whether they match any of the system colors, because most video drivers have slightly different values for the system colors. You should use `PC_RESERVED` instead. The code snippet in Figure 3 shows how to change the palette.

WinG provides a generic palette with `WinGCreateHalftonePalette`. Many people have created generic palettes, and some of these may be better than the WinG palette for your specific situation. However, if the WinG palette works well for you, I suggest you use it: It will be the generic palette for Windows 95 (code-named Chicago), Cairo, and most of the applications put out by Microsoft. If your game is sharing the palette with Paintbrush on Windows 95, there will be no palette war. Users will be happier because they won't see temporary false colors when they switch applications. If you need your own palette, by all means use it. However, if the difference between your generic palette and the WinG halftone palette is almost undetectable to the end user, I strongly suggest you use the WinG palette.

As an additional inducement, there is


```
// clear the existing palette
SetSystemPaletteUse (hdc, SYSPAL_NOSTATIC);
SetSystemPaletteUse (hdc, SYSPAL_STATIC);
PALETTEENTRY *pPeDest = &pe.palPalEntry[0];
for (int iOn=0; iOn<255; iOn++, pPeDest++)
{
    pPeDest->peRed = 0;
    pPeDest->peGreen = 0;
    pPeDest->peBlue = 0;
    pPeDest->peFlags = PC_NOCOLLAPSE;
}
hPal = CreatePalette (&pe);
HPALETTE hOldPal = SelectPalette (hdc, hPal, FALSE);
RealizePalette (hdc);
SelectPalette (hdc, hOldPal, FALSE);
RealizePalette (hdc);

// get the system palette entries
int iNumSys = GetDeviceCaps (hdc, NUMCOLORS);
GetSystemPaletteEntries (hdc, 0, 256, pe.palPalEntry);

// set to the new color table
RGBQUAD *pRgbDest = &hmi.rgb[0];
pPeDest = &pe.palPalEntry[0];

// first system colors
for (iOn=0; iOn<iNumSys/2; iOn++, pRgbDest++, pPeDest++)
{
    pRgbDest->rgbRed = pPeDest->peRed;
    pRgbDest->rgbGreen = pPeDest->peGreen;
    pRgbDest->rgbBlue = pPeDest->peBlue;

```

```
pRgbDest->rgbReserved = 0;
}

// our colors
RGBQUAD _far *pRgbSrc = ((RGBQUAD _far *) (&hmi + 1)) + iNumSys / 2;
for (; iOn<256-iNumSys/2; iOn++, pRgbDest++, pPeDest++, pRgbSrc++)
{
    pRgbDest->rgbRed = pPeDest->peRed = pRgbSrc->rgbRed;
    pRgbDest->rgbGreen = pPeDest->peGreen = pRgbSrc->rgbGreen;
    pRgbDest->rgbBlue = pPeDest->peBlue = pRgbSrc->rgbBlue;
    pPeDest->peFlags = PC_RESERVED;
}

// the last system colors
for (; iOn<256; iOn++, pRgbDest++, pPeDest++)
{
    pRgbDest->rgbRed = pPeDest->peRed;
    pRgbDest->rgbGreen = pPeDest->peGreen;
    pRgbDest->rgbBlue = pPeDest->peBlue;
}

// set the palette & WinG bitmap
DeleteObject (hPal);
hPal = CreatePalette (&pe);
SelectPalette (hdc, hPal, FALSE);
RealizePalette (hdc);
WinGSetDIBColorTable (gDC, 0, 256, hmi.rgb);

// OK, now Windows & WinG are set to the new palette.
// Don't forget to paint <g>

```



Figure 3: This code demonstrates how to change the palette by first clearing the existing palette and then setting the palette to the new color table.

the call `WinGCreateHalftoneBrush`. Under Windows you can get a dithered brush using the system colors or a solid brush mapped to the nearest color in the palette. What you cannot get is a dithered brush using all the palette colors. `WinGCreateHalftoneBrush` gives you a dithered brush using the full palette but uses the WinG halftone palette to do so. Therefore you can't do this with your own palette.

Like all Windows applications, a WinG game is limited to 236 palette entries (or 254 if you take over the screen). But aside from that—and tear problems (discussed below)—WinG makes Windows every bit as productive a programming environment for games as DOS. You draw to a DIB and blast it to the screen. It works and it's fast.

WHAT'S MISSING So what's missing? Surprisingly, not much. The one hole big enough to drive a truck through is that there is no support for optionally waiting on the hardware retrace. `WinGBitBlt` and `WinGStretchBlt` should include flags that tell them to wait (or not wait) for the retrace, but they don't. Because this feature is not supported, you will get tear when you BLT unless you use some indirect tricks.

Don't confuse tear with the problems of the old CGA card, which made you wait for the vertical retrace to update the screen. The problem with the CGA card was caused by its single-ported memory

design. This created visual distortions ("snow") when the CPU and the card accessed the memory at the same time.

Tear is what you get when you update a sprite while the screen is reading memory halfway down the sprite. On one pass, the video card displays the bottom half of the new sprite, and on the second pass, it displays all of it. This is called tear because you see the bottom half tear off and move first, followed by the top half.

The way tear is generally avoided is by waiting for the vertical retrace and then BLTing the bitmap to video memory. You can BLT faster than the video card reads memory, so you stay ahead. (If you want to get fancy, you can BLT without waiting by using the capability of some cards to determine whether the card is reading above or below your sprite.)

Second, there is no support for changing screen resolutions on the fly. Windows 95 will support this, but the capability is targeted for laptops used with docking stations. These requirements are very different from that of a game with 800-by-600 artwork telling Windows it wants to run at 800-by-600 resolution with 24-bit color when it's the active application. Maybe the Windows 95 API will end up being sufficient, but then again maybe not.

Third, there is no joystick support. The IBM joystick driver works, but it's a real-mode driver that is not cognizant of Windows and requires that the game synchro-

nize the joystick every time it starts. A Windows joystick-driver specification is needed, and it ought to ship with Windows 95. After all, a joystick is essential for many games, while a keyboard and mouse are often optional.

Finally, you cannot change the dimensions of a WinG bitmap. If my sprite code limits sprites to rectangles that contain 1,000 pixels for performance reasons, then I would like to create a single WinG bitmap that I could change from 100-by-10 to 50-by-20 to 10-by-100 to whatever I wanted with a call to WinG. Instead I have to create a 100-by-100 bitmap, and I never use 90 percent of that memory.

I believe WinG is the future. A year from now, DOS-based games will be rarities. Two years from now you just won't see them anymore, just as it's difficult now to find a DOS-based word processor in stores. The transition may occur even faster than this.

For those of you writing Windows-based games, WinG is a great opportunity; it lets you give game players what they are looking for. For those of you writing DOS-based games, it's time to get WinG and start work—porting. □

DAVID THIELEN IS A SENIOR DEVELOPER AT 7TH LEVEL, WHERE HE IS WORKING ON AN UPCOMING MONTY PYTHON GAME. PRIOR TO THAT, HE WAS A SENIOR DEVELOPER IN THE WINDOWS GROUP AT MICROSOFT. HE CAN BE REACHED AT 74104.467@COMPUSERVE.COM.

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Utilities

BY DOUGLAS BOLING

Raiders of the Lost DLL

The only thing expanding faster than the federal debt is the size of new Microsoft Windows programs. Some Windows programs today expect you to have 20MB of free hard disk space, or else they refuse to be installed. When they do let you install them, they fill those 20MB with dynamic link libraries (DLLs), many of which are duplicated in other directories on your hard disk. Even worse is the program that dumps a load of DLLs in your Windows directory or Windows system directory. Soon you're left with hundreds of DLLs on your disk and no way to tell which programs need them.

Installation programs such as technical editor Neil Rubenking's excellent INCTRL are great for monitoring installations, but what about all those DLLs already on your disk? There really hasn't been an easy way to determine which DLLs are used by which programs—that is, until now.

FDDLLS (short for Find Dead DLLs) is a program that scans your hard disk to seek out DLLs and the programs that put them there. FDDLLS lists all Windows executable files and determines which ones require which DLLs. You can then scan the list of files and separate the needed DLLs from those that are duplicates or are no longer necessary.

FDDLLS does not actually delete any files; that delicate task is left to you. What FDDLLS does is make it easier to find DLLs and determine the links between programs and DLLs. The list of DLLs and .EXE files can be sorted by name, extension, path, or number of references to make it easier to determine which DLLs are used where. When you see an entry

you'd like to know more about, double-click on it to see a dialog box listing all the files that reference the file you're interested in, as well as a list of all files referenced by that file.

You can download FDDLLS from PC MagNet's Utilities/Tips Forum archived as FDDLLS.ZIP. For details, see the sidebar "Guide to Our Utilities and How to Get Them." For those interested in modifying FDDLLS for their own use, the C source and other necessary files are provided. FDDLLS was written with Microsoft C 6.0, and should work with most C compilers; make files are provided for the Microsoft C 6.0 and Borland C++ 3.1 compilers.

USING FDDLLS To install FDDLLS, just copy it to a directory on your hard disk, preferably one listed in your path statement. Using the File|Run menu on the Program Manager, you can enter the name FDDLLS and click on the OK but-

ton. If you copied FDDLLS into a directory not in the path, you will need to specify the complete path so that Windows can find the program. If you think you might use FDDLLS often, create a Program Manager icon using the File|New menu selection. You can then start FDDLLS by double-clicking on the FDDLLS icon.

When you start FDDLLS, you will see a dialog box that asks you if you want to scan your computer right now. The drives to be scanned are listed in the dialog box. If the dialog box correctly lists all the non-removable drives on your machine, click on the Scan button to start the scan. If you want to include an additional drive such as a CD-ROM drive, click on the Select Drives button to choose the drives to scan.

The scan takes place in three phases: First, all directories are searched for files with extensions .EXE, .DLL, or any of the other Windows-executable extensions listed in WIN.INI. Next, each of these files is examined to determine whether it is executable under Windows and, if it is, what files it references. This phase of the scanning takes the longest, perhaps 45 seconds for 500MB of disk space. The final phase checks to see whether any DLLs not referenced by filename are referenced by some other name.

During each phase of the scanning, the FDDLLS status line will display a progress indicator. Since the scan takes some time, FDDLLS was designed not to monopolize your machine while it is scanning. You can work with other programs during the scan, though you will notice some performance degradation due to FDDLLS's extensive disk operations. If you want to stop the scan prematurely, select the File|Stop menu item.

Once the scan is completed, FDDLLS will display a list of all the Windows executable files it found, sorted by filename. The list will also include the type of file listed (either "Program" or "DLL"), the size of the file, and the number of references made to the file by other files on your disk. If FDDLLS finds a file that references a DLL that could not be found, the entry will be displayed in red. Files with duplicate names will be listed in blue.

You can have FDDLLS display only the executable files, only the .DLL files, or both. To specify which files are displayed,

Top 10 Utilities

Rank	Utility
1	WTIME - Keeps PC clock accurate
2	FINDIR - Locates available IRQs
3	INCTRL - Control Windows' installation
4	MONITOR - Monitors system resources
5	BAT2EX - Compiles batch files
6	THINDI - Streamlines hard disk
7	SWITC - Creates multiple Windows setups
8	BUGS - Windows 3.1 screen saver
9	PRUNE - Manages DOS files
10	MBOOT - Multiple boot program

This list is based on the total number of downloads each utility has had on PC MagNet over the past month. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

pull down the View menu and select the option you want. By default, FDDLLS displays the path along with the filename. If you prefer to see the filename only, you can select the View/Display Path menu item, which toggles between displaying the path and not displaying the path.

The Sort menu contains selections for specifying how the list is to be sorted. You can sort the list by name, extension, path, module name, or reference count. Except for reference count, all sorts are shown in ascending order. The reference count is sorted in descending order with the most-referenced file, almost always KRNL386 or KRNL286, at the top. The final menu item, Help/About, displays the About box with the program name, copyright notice, and author's name.

Before we start hunting for unneeded DLLs, a strong word of caution: Some DLLs that appear to be orphaned are actually needed, such as those called by programs run from CD-ROM. The *worst* thing you can do is erase apparently unneeded DLLs from your disk without backing them up. Instead, you should move them to a floppy disk, or to a separate directory not listed in your path. Then if you find you really do need a certain DLL, you can restore it to your system without reinstalling the program that calls it.

Now let's start the hunt. First, create a temporary directory called SAVEDLL somewhere on your disk. Make sure this directory is not in the path. Now run FDDLLS using the instructions above. When the Scan Disk dialog box appears, select all the hard disk drives on your system and press Scan.

When the scanning process is complete, scroll down the list of files presented by FDDLLS. If you see an entry listed in red, stop. The red highlight indicates that FDDLLS could not find a library required by this program or DLL. This file is a prime candidate for moving to the SAVEDLL directory, because it can't be run without the missing library.

Double-click on the red entry. You should see one or more entries with the string "Lib not found:" in the File Dependencies box in the lower-right-hand corner of the dialog box. These are the libraries that FDDLLS could not find. If an entry is a program (rather than a DLL), you should attempt to run it to see if Win-

dows can find the DLL that FDDLLS could not. Though this is unlikely, it could happen if the program looks for the file in the current directory. If Windows can't find it either, you will see a dialog box that says the DLL is missing.

After you've moved all the files whose DLLs are missing, it's time to look for duplicate DLLs. Go to the Show menu and select DLL Files Only so that FDDLLS will only display DLLs in the list. Select the Show/Display Path menu item so FDDLLS will only display the filenames. Now scroll down the list, noting entries highlighted in blue. These are the DLLs that are listed more than once.

You will probably see that one of the duplicate DLLs will have all the references, while the others are not referenced. The DLL with all the references is in a directory that is searched before the directories that contain the other like-named DLLs. If the others are true duplicates, that's the one to keep; the rest are just burning disk real estate.

Some like-named DLLs may have different sizes. These are clearly not duplicates, even though they have the same filename. If both are referenced, you would be wise to leave both on your hard disk; it's common for programs to require an older version of a DLL. Just because two DLLs have the same name is no reason to assume that one can replace the other.

Before deleting anything, you need to check whether the DLLs are actually duplicates. To do this, bring up the File Information dialog box for the like-named files. This displays the size and date of the file. Compare this information with that for the duplicate DLLs. If the information matches, most likely the DLLs are duplicates. If you want to be 100 percent sure, use DOS's FC or COMP command to compare the files. The duplicate DLLs with no references can be moved to the SAVEDLL directory.

When two duplicate DLLs are both referenced, you have to do a bit more research before moving one of them. When a program loads a DLL, Windows searches in the following order:

1. the current directory;
2. the Windows directory;
3. the Windows System directory;
4. the directory where the program

asking for the DLL is located;

5. the directories listed in the path; and
6. the directories mapped in a network.

Only two directories—the current directory and the directory of the program requesting the DLL—can be different for different programs. Thus for both duplicate DLLs to be referenced, one of them must either be in the directory of the program requesting it or in the directory that is the current default when the program is executed. The "current directory" problem is more subtle since the current default directory for the Windows desktop is not always apparent.

You can determine which file is referencing a DLL by double-clicking on the file reference entry in the File Information dialog box. This will display data on the referencing file. If a DLL is only referenced by a file in its own directory, and another copy of the DLL is referenced by all other programs, you can try moving the DLL to the SAVEDLL directory and running the program that referenced it. If the program does not run correctly, you should move the DLL back to the referencing program's directory.

Now we will look for orphaned DLLs. Select the Sort/By Reference Count menu item to sort the list in order of number of references. You should see either KRNL386.EXE or KRNL286.EXE at the top of the list, followed by USER.EXE and GDI.EXE. All are part of Windows and, in spite of their extensions, are DLLs. Scroll down the list to the files that have no references. These DLLs were not referenced by any other program on your machine.

The key to removing these DLLs safely is to figure out why there are no references. There are many valid reasons why a DLL may not be referenced. If you use the Setup program to switch between different display, keyboard, or network drivers, the ones currently not used will be in your Windows system directory but will not be referenced. If a DLL is referenced by a program on CD-ROM, it will appear to be orphaned. DLLs will also appear unreferenced if they are loaded at runtime, rather than when the program is first launched. This is the case with any Visual Basic program. Since DLLs loaded at runtime are not listed in the .EXE header, there is no way for FD-



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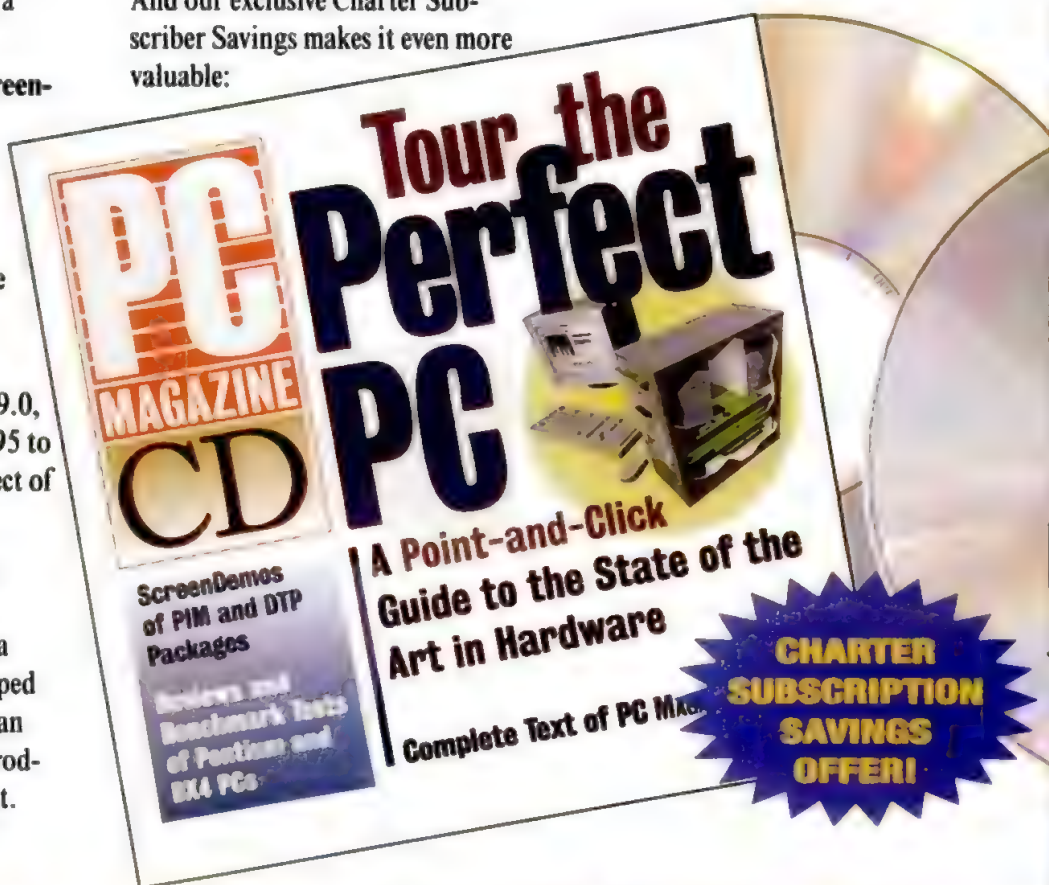
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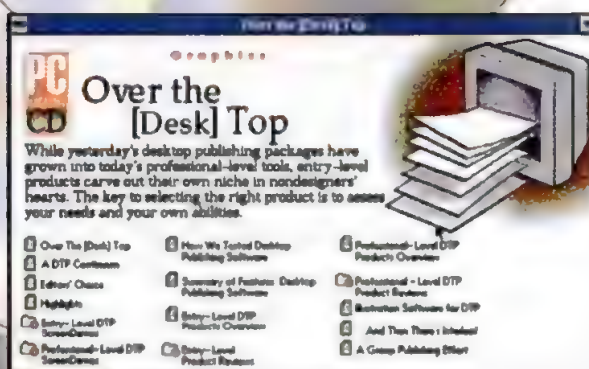
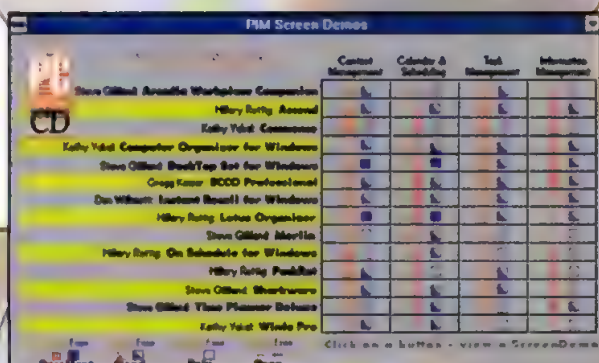
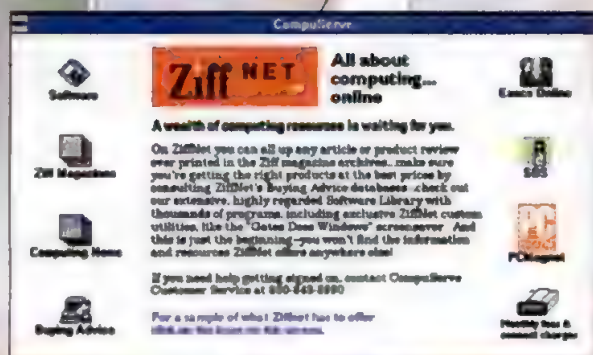
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DLLS to know they are needed.

People with Windows program compilers on their systems will encounter another type of false flag. FDDLs will flag DLLs in the compiler directories that are put there for distribution with programs you write. These DLLs will usually be present in the Windows or Windows system directory as well, but it's safer not to delete them.

If you delete one of these DLLs, the next time you switch to another display resolution or network driver, or load your CD-ROM software, you will need your installation disks. Removing DLLs is an exercise in judgment. FDDLs provides useful information, but remember that by moving and erasing DLLs you are messing with the very heart of Windows.

DYNAMIC LINKING As mentioned at the start of this article, DLL stands for dynamic link library. But exactly what is a DLL, and what is so dynamic about it? To explain, we will make a quick trip back to the basics of how programs are created.

Compilers for high-level languages such as C or Pascal convert program statements into the machine language used by the target microprocessor. In places where the programmer has called a library routine, a `call` opcode is inserted with a dummy target address. The compiler keeps a list of these dummy addresses so they can be "fixed up" later with proper addresses.

The addresses for static library routines are resolved during the link step, which creates the .EXE file. The addresses for dynamic link library (DLL) routines are resolved at runtime. The operating system loads the program and then performs the linking operation before executing the program.

DLLs (which are made possible by the operating system) are handy for a number of reasons. First, multiple programs can access a DLL at once. This means the DLL need only be loaded once, regardless of the number of programs using it. With static libraries, each program has its own, personal copy of the library routine. If many programs require the same routine, creating the routine as part of a DLL will save memory.

Another advantage of using DLLs is that they can be updated without modifying or recompiling the applications that

use them. For example, the transformation to the "3-D button" look that appeared in OS/2, Version 1.2, and later in Windows, Version 3.0, was accomplished by changing DLLs rather than recompiling the applications.

To provide dynamic linking, Windows must know which library routines the program will call and in which files these rou-

Offset	Contents
0	'N' (signature byte)
01	'E' (signature byte)
02	Linker major version
03	Linker minor version
04	Entry table offset (relative to start of new .EXE)
06	Entry table length
08	Reserved
0C	Module flags
0E	DGROUP segment number
10	Size of initial local heap
12	Size of initial stack
14	Starting IP
16	Segment number of initial CS
18	Starting SP
1A	Segment number of stack
1C	Entries in segment table
1E	Entries in module ref table
20	Length of nonresident names table
22	Relative offset of segment table
24	Relative offset of resource table
26	Relative offset of resident names table
28	Relative offset of module reference table
2A	Relative offset of imported names table
2C	Relative offset of nonresident names table
30	Number of movable entry points
32	Shift count used for segment alignment
34	Number of resource table entries
36	Target operating system
37	Additional information flags
38	Offset in sectors to start of fast-load area (Windows only)
3A	Length in sectors of fast-load area (Windows only)
3C	Reserved
3E	Expected version number for Windows (Windows only)

Figure 1: This is the format of the New Executable (NE) header. Note that the table offsets are relative to the start of the header.

tines are located. Windows executables contain a number of lists that contain this information. Three of these lists are important to FDDLs. First, there is a list of the modules that contain import routines the program needs to call. The second list contains the names of these external rou-

tines and a number indicating which module contains the routine. The third list contains the routines this program can export to other programs or DLLs. But where are all these lists stored?

Windows executables use what is known as the New Executable (NE) format, which was first designed for a multi-tasking version of DOS sold only in Europe. It was later used for both Windows and OS/2 1.x executables. The format contains a small DOS program within the main program, stored near the start of the file. This *DOS stub*, as it is called, is what is executed if a Windows or OS/2 1.x program is run from the DOS command line. Usually, it simply displays the message "This program requires Microsoft Windows" or "This program requires OS/2" and then terminates.

Just past the DOS stub resides the New Executable header. As shown in Figure 1, the characters "NE" appear in the first two bytes at the start of this header. The fields important to our discussion are located at hexadecimal offsets 36, 0C, 1E, and 26. The Target Operating System byte at offset 36h indicates which operating system the program is written for. Its value can be one of the following:

- 0 Unknown
- 1 OS/2 1.x
- 2 Windows 3.x
- 3 European DOS 4

(European DOS 4 is different from American DOS 4.)

The Module Flags byte at offset 0Ch contains bit flags indicating what type of code is contained in the file. Among other things, it tells whether the program contains 286 or 386 instructions and—the item important to us—whether the file is an executable file or a dynamic link library. If bit 15 of the Module Flags byte is 1, the file is a DLL; otherwise the file is a program.

The last two offsets, 1Eh and 26h, contain the number of nonresident entries (called *routines* and stored in another module) and a pointer to the module reference table. This table contains a list of all the DLLs that the program or DLL may call after the program is loaded.

The table itself has an interesting format. It is composed of 16-bit offsets to

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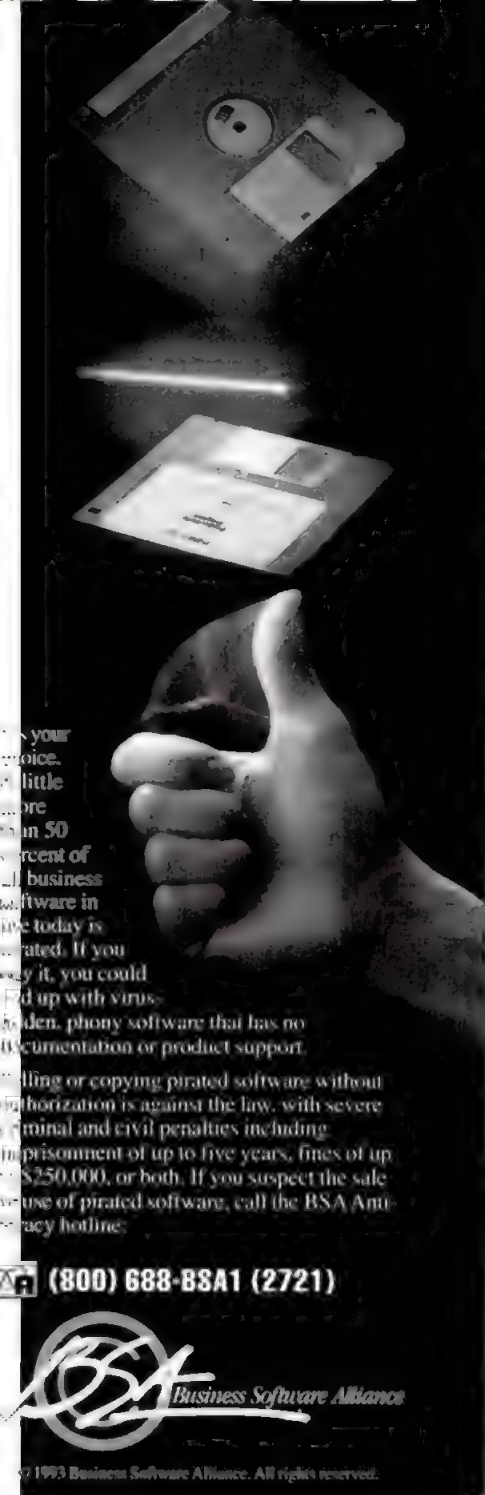
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numbered strings that contain the names of the modules necessary for the program. These offsets are based from the end of the module reference table. This rather strange number can be converted to an absolute offset from the start of the file with the following computation.

```
Offset of the New Executable header
+ Offset of start of the module
  reference table
+ Total number of entries in the
  reference table * 2
+ Index of entry in the reference
  table
-----
= Offset of string containing the
  module name
```

This final value points to a "counted string," that is, an ASCII string with the first byte being the length of the string. (This string is not zero-terminated.)

To sum up: To determine which DLLs a Windows program needs, you must first determine that it is a Windows program by finding the NE header and looking at the Target Operating System byte. Second, you must locate the module reference table. Finally, the pointers in the module reference table must be converted into offsets into the file so that the module names themselves can be read.

MATCHING DLLs WITH PROGRAMS To work, FDDLLS must read the module names from the header of every Windows program and DLL on the machine. Since this is an extremely disk-intensive process, FDDLLS attempts to minimize disk accesses whenever possible.

FDDLLS first searches all the directories on all the hard disks for files with the .DLL and .EXE extensions, as well as any files with extensions listed in the programs= line in the WIN.INI file. (Although the .BAT, .COM, and .PIF extensions are listed on the programs= line, FDDLLS ignores these extensions since they do not indicate Windows executables.)

A list of all these programs found on the disk is created in memory. The list contains the filename, the directory in which the file is located, its size and date, and a set of fields that will be filled in later in the scan. Because this list is always kept in memory, FDDLLS never has to search the disk again for files. This dramatically in-

creases the speed of the file searches FDDLLS has to perform later in the process.

Once the list has been compiled, FDDLLS opens each of the files in the list and checks to see if it is a Windows executable. Many of the files with an .EXE extension will be DOS programs rather than Windows programs and therefore can be ignored.

If the file is a Windows program or DLL, FDDLLS looks at the header for the list of required DLLs. FDDLLS searches the proper directories for each DLL on the list in the same order that Windows uses to search for a DLL. When a DLL with a matching name is found, an entry is added to a cross-reference list that contains the relationships between all programs and DLLs in the system. A count is also kept of the number of DLLs the program needs that are not found. This count is used later, in the third pass of the scan. FDDLLS also reads the module name of the program or DLL, which is the first entry in the module reference table. This information is also used in the third pass of the scan.

Searching for every DLL needed by every Windows program on a disk could be quite time-consuming. For this reason, the list of programs is kept in memory so the DLL searches do not require disk access. What does take time is opening and reading each of the programs on the disk to determine which are Windows programs and DLLs, and which DLLs each of the programs needs.

After all the programs have been examined, FDDLLS makes one more pass through the list. The third pass is used to locate DLLs loaded by module name instead of filename. While normally the module name is the same as the filename, it can be different. A third pass is necessary because the module names are not available until all the files have been examined. To speed the search, FDDLLS only reexamines programs and DLLs for which at least one DLL was not found.

Once all files have been scanned, FDDLLS examines the list of programs and loads names of Windows executables or DLLs into the listbox. To sort the listbox, FDDLLS intercepts the WM_COMPAREITEM message and compares the entries in the manner the user selected in the menu.

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Creating the File Information dialog box is actually quite simple. When a user double-clicks on an entry in the list, FDDLLS creates the dialog box and passes a pointer to the entry in the list to the dialog box. When the WM_INITDIALOG message is sent to the dialog box, the dialog box code uses the pointer passed to find the entry for the program in the list. Most of the fields in the dialog box are filled by

simply reading the data from the list entry for the program. The Referenced By and File Dependencies lists are filled in by scanning the cross-reference list for pointers back to the file being checked.

FDDLLS takes advantage of the structure of the New Executable file format to determine the relationships between programs and their DLLs. This information provides a great deal of insight into the

routines a Windows program calls. In the case of FDDLLS, the specific routines are not interesting; the DLLs themselves are. FDDLLS assumes every DLL is excess baggage unless it is referenced in a program or another DLL. Try FDDLLS and lighten that DLL load. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF PC MAGAZINE.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

FDDLLS

PURPOSE: FDDLLS helps you find unused DLLs on your system by finding, sorting, and classifying Windows executable files. FDDLLS can list the .EXE and .DLL files on your system by name, extension, or reference count.

SETUP: To install FDDLLS, simply copy it to a directory on your hard disk and create an icon for it in the Program Manager. Then double-click on the icon to load the program.

After FDDLLS is started, click on the Scan button to enable FDDLLS to search your hard disk for Windows executable files. You can specify which disks are to be scanned by clicking on the Select Disks button. In general, all nonremovable disks must be scanned for FDDLLS to work properly.

FDDLLS lists the executable files and DLLs in order by name. All .EXE or .DLL files that require DLLs not found on the machine are listed in red. Files with duplicate names are listed in blue.

REMARKS: Do not delete DLLs that appear to be unused. Instead, move suspect DLLs to a directory not listed in the PATH statement. It's impossible for FDDLLS to show all needed DLLs as referenced. DLLs loaded at runtime, such as those used by Microsoft Visual Basic programs, will be incorrectly identified as orphans. Programs run from CD-ROM drives will also cause false positives. Yet another common situation will cause misidentification: having drivers installed for sound cards, video cards, or networks that are not currently in use.

If you delete a DLL which is needed by a program, you will have to reinstall that program. A much safer solution is to move DLLs that seem to be orphans to a separate subdirectory or to a floppy disk. DLLs should never be deleted.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

HARDWARE

Hard Disk Hassles

❓ I'm trying to use a Micropolis 1325T hard disk from an old IBM-XT as a second hard disk in an IBM PS/2 Model 60 (which already has a 40MB hard disk), but after I hook up the cables and reboot, I can't access the second hard disk. Could the old format of the Micropolis be incompatible with the PS/2 disk controller? Is there any way to install this hard disk without losing all its data?

Jonathan Davis
Lexington, Oklahoma

► **PC MAGAZINE:** The PS/2 Model 60 came with an ST-506 MFM-compatible controller—the same type used in the old XT. The Micropolis 1325T is designed to work with such a controller, so it's unlikely that compatibility is the problem. It sounds instead like you need to change a jumper on the Micropolis.

Many users are familiar with the Master/Slave settings of IDE drives. Similarly, MFM drives indicate a *drive number* to the computer with jumpers that you must set. The choices may be numbered 0 through 3 or 1 through 4; your Micropolis uses 1 through 4. Most likely, the jumper is currently on the J3 pair of pins (the drive 1 setting). Move it to the J4 pair to select drive 2.

Also, make sure that you've attached this second hard disk to the *middle* connector on the hard disk data cable. (Your first hard disk should already be attached to the last connector.) Finally, you must remove the terminating resistor pack from the second hard disk. This is a plastic rectangle (typically yellow but sometimes black or blue) with a straight line of pins. It will be located next to the configuration pins on the hard disk.

These changes should allow your PS/2's controller to see the second drive and let you access the data on it.

Note that it's always a good idea to back up any important data *before* you start playing with hardware configurations. This means copying both the data on the Micropolis before you take it out of the XT and the contents of the PS/2's hard disk. There's always the remote chance that something could become seriously damaged (by, say, an accidental drop to the floor) while being handled.

—Alfred Poor

Dummy-Down the Printer

❓ After reading your printer extravaganza issue, I'm interested in units that can auto-switch between PostScript and HP LaserJet PCL modes, but I have one concern: Sometimes I write programs directly in PostScript. If I attempt to send the listing of such a file to an auto-switching printer, the device will switch to PostScript mode and interpret the code rather than simply print it as text. Do you know of any way around this?

Kenneth Tanzer
Brooklyn, New York

► **PC MAGAZINE:** Most printers let you choose between PostScript, PCL, or auto-switching modes, so the answer is (usually) easy—turn off auto-switching. In the early days of auto-switching printers, our reviews would point out these choices. Now that the feature has become more common, we tend not to state explicitly that you can disable auto-switching.

This solution could be a hassle if you want to change modes frequently, since it typically involves working your way through a number of menus on the front panel of the printer. Fortunately, most printers have multiple active I/O ports that can be configured differently, so (assuming you have more than one available port on your PC) you can use one port for auto-switching and a second for PCL-only. In this case, you'd send PostScript jobs (and all general output) to the auto-switch port and PostScript file listings to the PCL port.

Many printers also have a command that will allow you to specify the mode. For HP LaserJets, for example, it is possible to switch to PCL using the command `@JPL ENTER LANGUAGE = PCL`. You will need to check with the manufacturer or the user's manual to see if such a command is available for the

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printer you are considering.

A third solution takes some experimentation, since different printers handle auto-switching differently, but you may be able to trick your printer into thinking the print job is in PCL when it's actually a PostScript listing. Put an innocuous Escape command at the start of the file (Escape-E, the PCL reset command, is a good candidate) and the printer may interpret the remaining data stream as PCL rather than PostScript. Just remember to delete the PCL characters from the file before you put it to work as PostScript code.—*Alfred Poor*

OPERATING ENVIRONMENTS

Using a Menu Batch File Under Windows

I wrote a series of batch files similar to those in the "Creating a Menu System" section of the DOS 5.0 manual. The first to execute, MENU.BAT, displays a numerically ordered list of options, instructs you to pick a number, and then exits to the DOS command line. When you type a number followed by the Enter key, the appropriately named batch file (1.BAT,

2.BAT, 3.BAT, and so on) starts. Unfortunately, I run the menu system from Windows, which reasserts control as soon as MENU.BAT terminates, so I never get the chance to type a number. I've tried creating a MENU.PIF file and deselecting the Close Window on Exit check box, but running MENU.BAT still pops me back into Windows (which now contains an inactive DOS window). How can I configure Windows or the batch files or both to shell to DOS and stay there until I type EXIT at the command line?

*Richard Goldman
North York, Ontario, Canada*

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M. David Stone is a contributing editor and coauthor of *Word for Windows Companion*, Second Edition.

Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

► **PC MAGAZINE:** There are at least three solutions to the problem you're having. If you're running DOS 6.0 or a later version, you can use COMMAND.COM's new /K switch, which is similar to the existing /C switch. COMMAND /C *string* loads a secondary copy of COMMAND.COM, executes the command string following the /C, and then terminates the secondary COMMAND.COM. COMMAND /K *string* works similarly but leaves the secondary COMMAND.COM running. Use the Program Manager's File|New menu selection to create a new program item with the command line COMMAND /K MENU.BAT and then select the Change Icon button (and click on OK in the warning dialog you'll receive) to assign one of the Program Manager's icons to your new item. Your menu system should work fine when you run it from the icon.

If your DOS version is earlier than 6.0, there's still hope. To effect a quick fix, add these lines to the end of MENU.BAT:

```
IF '%inmenu%'=='Y' GOTO Continue
SET inmenu=Y
COMMAND
:Continue
```

Now, the first time MENU.BAT executes, it will load a secondary copy of COMMAND.COM. All of the numbered batch files and subsequent executions of MENU.BAT will take place under this secondary COMMAND.COM. The downside is that the DOS copyright notice will appear at the end of your menu the first time it's displayed.

Another solution circumvents the DOS prompt entirely by taking user input within MENU.BAT. Figure 1


```
@ECHO OFF
:Top
CLS
ECHO      Start Menu
ECHO.
ECHO {Insert lines listing numbered options here}
ECHO.
ECHO Type a number or EXIT, press Ctrl-Z, and press Enter
COPY CALLIT.DAT + CON CALLIT.BAT > NUL
CALL CALLIT.BAT
PAUSE
GOTO Top
```

Figure 1: The batch file menu plan described in the DOS 5.0 manual must be modified to work under Windows.

shows a sample MENU.BAT that uses this technique. The COPY command appends the user's input (terminated by Ctrl-Z and Enter) to the contents of CALLIT.DAT, a tiny file that contains nothing but the word "CALL" followed by a space but *no* carriage return or line feed. The result is stored in CALLIT.BAT. The next line executes CALLIT.BAT, which will contain a line like CALL 1. When 1.BAT finishes, it reexecutes MENU.BAT, so the system keeps running until the user enters EXIT. What if the user types a wrong number? The

ing Enter. On the next line, type CALL followed by a space; then Ctrl-Z. Press Enter again and you should see the message "1 file(s) copied," indicating that the 5-byte CALLIT.DAT has been stored in the current directory.—Neil J. Rubenking

More on Oddball Filenames

TIP Your March 29, 1994, Solutions column covered several ways of handling oddly named files. If you have DOS 6.x,

though, there's another, little-known method. The DELTREE and MOVE commands let you delimit parameters simply by enclosing them in quotes. Thus you can issue commands such as MOVE "WPC K" WPC_K or DELTREE "WPC K" to handle those files with troublesome names.

Dan Rollins
La Crescenta, California

► **PC MAGAZINE:** Little-known is right—this is the first I've heard of this technique. Using quotation marks lets you deal directly with filenames containing spaces, rather than indirectly by way of wildcard file specifications. For that matter, if you ever feel the need to experiment with filenames containing spaces, you can also use MOVE to create them. Using quotes around MOVE's second parameter, like this:

```
MOVE NOBLANKS.DAT "2 BLANKS.D T"
```

lets you create a filename that contains spaces.—Neil J. Rubenking

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Replacing the Windows Start-Up Logo

❓ I'd like to substitute a different graphic image, such as my company logo, for the blue Microsoft logo that now appears when Windows starts up. Is there any way to do this?

Raymond Au
Atlanta, Georgia

► **PC MAGAZINE:** This question comes up again and again, but it's been a while since we've answered it. Yes, you can change the start-up logo, and it's not difficult. You need to convert the desired image into a 16-color RLE compressed bitmap format (sometimes called RLE 4). Many packages for image viewing and processing allow you to convert from standard Windows BMP (bitmap) files to RLE files.

In the System directory (usually C:\WINDOWS\SYSTEM) you'll find a file called VGALOGO.RLE; rename this file VGALOGO.OLD. Now move your own logo image file to the System directory and change its name to VGALOGO.RLE. From the DOS prompt, run the Windows SETUP program, note your current display driver, and change to a different driver. Run SETUP again, and select the original display driver. That's it! SETUP builds a new version of WIN.COM, the program that starts Windows, and the new version incorporates your logo.

One warning: If the WIN.COM built using your logo is larger than 64K, it won't work. Be sure to keep your RLE logo file under 45K or so and you shouldn't have a problem.—Neil J. Rubenking

WORD PROCESSING

Loading the Current Template in WinWord

✓ **TIP** Microsoft Word for Windows makes it easy to add or change most customizations in an attached template while working in a standard document. AutoText entries, key assignments, macros, and customized menus and toolbars all come under this category. But there is no easy way to add or change boilerplate text in the template while working in the doc-

ument. Instead, you have to find the template, open it, make whatever changes are needed, and save it.

If you work on a LAN and use both a local template directory and workgroup template directory, so that templates are

scattered over several drives on several computers, simply hunting down the right template can be a chore. And finding your way back to your original working directory after you've finished with the template compounds the chore.

The macro in Figure 2 lets you open the template attached to the currently active document. If you decide to change the wording in the template while you are working with the document, you can simply run the macro to open the template, make your changes, save the template, and return to the document. Note that the FileOpen command in the macro includes the argument .AddToMru = 0. This keeps the template from showing up on the list of most recently used files.

Arek Pfeffer
Wildomar, California

► **PC MAGAZINE:** Although AutoText entries—*glossaries* in WinWord 2—are the right place for most boilerplate text, there are some cases where the text belongs in the template's editing area (for lack of a better name). Forms are an obvious example. In those cases, having to change directories to find the template can be tedious even on a stand-alone system with all the templates in one directory.

When you make changes in the editing area of a template, those changes will show up only on documents you haven't created yet. If you want the changes to appear in your current document, you'll need to copy them to the document after making the changes in the template. Alternatively, you can close the document after making changes in the template and start over again by opening a new document based on the new version.

Aside from being useful for its own sake, the macro in Figure 2 (available in

```
Sub MAIN
Dim dlg As DocumentStatistics
GetCurValues dlg
CurTemp$ = dlg.Template
button = MsgBox("Do you want to edit " + CurTemp$ + "?",
36)
If button = 6 Then Goto bye
FileOpen .Name = CurTemp$, .AddToMru = 0
bye:
End Sub
```



Figure 2: This WinWord 6.0 macro lets you load the currently attached template. To use the macro in WinWord 2.0, delete everything in the FileOpen line after CurTemp\$, starting with the comma.

PC MagNet's Utilities/Tips Forum as LDTEMP.DOC) demonstrates a handy technique for obtaining information from a WinWord dialog box and then using the information. Briefly, the first two lines after the Sub MAIN statement create what amounts to a copy of the built-in Document Statistics dialog box. They name that copy dlg and fill in the blanks with the current values for the document. The third line defines a variable, CurTemp\$, using the current value for the Template as stored in dlg.

The fourth line uses the MsgBox() function to define a simple dialog box that asks if you want to edit the current template. The 36 at the end of that line is the sum of 32, which tells WinWord to add a question icon to the dialog box, and 4, which tells the program to add a Yes button and a No button. The line also defines the variable button, which will have a value of 0 if you choose No or 1 if you choose Yes. The next line tests for the value of button. If you chose No in the dialog box, the macro jumps to the label bye and does nothing with the information. If you chose Yes, the macro continues to the next line and runs the FileOpen command to open the template. Note that the WinWord 2.0 macro language does not include the .AddToMru argument. But you can use this macro in WinWord 2.0 if you delete everything after CurTemp\$ on the FileOpen line, starting with the comma immediately after CurTemp\$.—M. David Stone

DATABASES

Editing DOS FoxPro Help Files

✓ **TIP** One of the most time-consuming areas of Microsoft FoxPro for DOS appli-

Only
Midwest Micro
Could Alter
Scrooge's Fate...



The Ghost of Computers Present—& Future



While Scrooge waited patiently for instructions from the ghost, he grew more and more curious about the strange clutter in their midst. What could be the meaning of these mouth-watering foods mixed with mysterious computer products — the likes of which the old man had never seen?! Finally his answer came...



"I was sent to deliver the Present and Future of computer technology," the ghost bellowed. "These Intel-based Elite Systems which surround us have captured the extraordinary powers of PCI and Pentium. It is now up to you, Ebenezer, to release them"

The spirit's thundering voice sent chills up Scrooge's brittle spine.

"Please, wise spirit, have mercy upon me. Tell me more about these 'Elites', and what I, a mere mortal, must do to help your cause."

"Many of these fine Elite Systems contain a powerful Intel Pentium Processor," explained the ghost, "capable of 60, 66 or 90 MHz speeds." Scrooge never dreamed anything could move so quickly.

"While others," he continued, "rely on formidable 486 processors and advanced PCI Local Bus architecture for their impressive performance.

The spirit now turned to the system closest to him, a P5-90 Home PC – and with a single touch, brought its 15" monitor to life.

"Fear not, Scrooge," said the ghost. "Touch the key of your choice, and we shall begin."

Scrooge's trembling index finger came to rest on the symbol that was the dollar sign – in an instant the screen erupted into a multimedia frenzy. Without leaving the room, he saw himself walking about the streets of London – peering into the lives of those less fortunate. He could almost feel the cold air biting his bare feet...smell the aroma of a Christmas goose cooking. He even heard a choir of small children singing.

"Where do these angelic voices come from, spirit?" he asked.

"Altec Lansing Stereo Speakers," said the ghost.

The spirit then explained that it was the combination of a Pentium Processor, superscalar architecture and advanced PCI Local Bus technology that allowed this Elite to access peripherals with such haste.

When the adventure was over the ghost turned off the system and looked down earnestly upon Scrooge.

"These people you have just witnessed hunger desperately for power. Without an Intel-based Elite System in their lives, I shudder to think what may become of them. You must tell them of Pentium and PCI – of MidWest Micro's affordable PCI, Home PC and Pentium Processor Based Systems!"

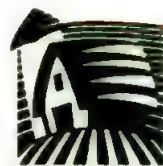
"You have my word," promised Scrooge.

"And you, Scrooge, do you hunger as well?"

"Yes, spirit. I too could benefit from the power of an Elite."

"No," said the ghost, "I mean are you hungry? I fear I cannot eat all this food without help."

And since Scrooge did not expect another spirit until the bells tolled one, he seated himself with the ghost among the awe-inspiring Elites – and thus began to feast.



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rembling at the sight of Jacob Marley's ghost, Ebenezer Scrooge still managed to utter one more "Bah Humbug!" Perhaps it was just a bad chestnut or bite of plum pudding causing him to hallucinate. As he was pondering this, the vision spoke...

"Poor old Ebenezer," his dead partner moaned. "This is neither a dream nor indigestion. I have come to warn you before it's too late — you see, these chains I bear are those I forged in life. And unless you change your way of computing, this will be your fate as well. Like you, I believed a faster, more versatile machine was the key to prosperity. Unfortunately, this obsession with power kept me chained to my office — day in and day out. In my search for the perfect computer, I encountered only a few desktop systems swift enough to suit me — but alas, they were dreadfully heavy. And the portables? Why, I fear my horse-drawn carriage could run faster."

Scrooge nodded in agreement, for he recognized Marley's plight.

"Tell me, Jacob, whatever can I do?" he asked.

"Hold onto your nightcap, Ebenezer — for you will scarcely believe what you are about to witness."

Scrooge looked closely at the object floating above Marley's wrinkled hands.

"Why, it's just another notebook," he said.

"No," shrieked Marley, "this is the Elite SoundBook Plus based on Intel's Pentium Processor. It's like no other notebook you've ever seen...or heard!"

"And it dares to challenge my full-size computer?" asked Scrooge in amazement.

"Did my words escape you, old man?! The Elite SoundBook Plus has captured the power of Pentium! Couple that with its remarkable PCI Local Bus architecture, high-speed synchronous cache and 16-bit stereo sound— and this 90 MHz notebook more than 'challenges' your cumbersome computer... it clearly outperforms it!"

"But a portable Pentium?!" gasped Scrooge. "A talking 90 MHz notebook?! It's pure humbug I tell you."

Yet Ebenezer prayed this spirit spoke the truth. For an invention such as this would surely double his productivity — and thus free him from his dark and gloomy office. Marley then summoned the Elite 486 SoundBook with business audio features and an assortment of delightful screens, rapid processors and generous hard drives to choose from.

"Oh thank you, Jacob," cried Scrooge. "Thank you for delivering these remarkable notebooks from heaven's gates to my humble chambers."

"Heaven, indeed!" laughed the ghost. "Elite SoundBooks are found right here on earth — but only at MidWest Micro.

"Then what about the price?" asked Scrooge. "Notebooks such as these surely cost a full year's wages!"

"Wrong again," said Marley. "MidWest Micro knows you don't want to pay extra pounds any more than you wish to carry them. That's why they offer these lightweight Elites at prices even your employees can afford."

And without another word, the late Jacob Marley was gone...leaving only a puff of smoke and MidWest Micro's toll-free number behind. ❧



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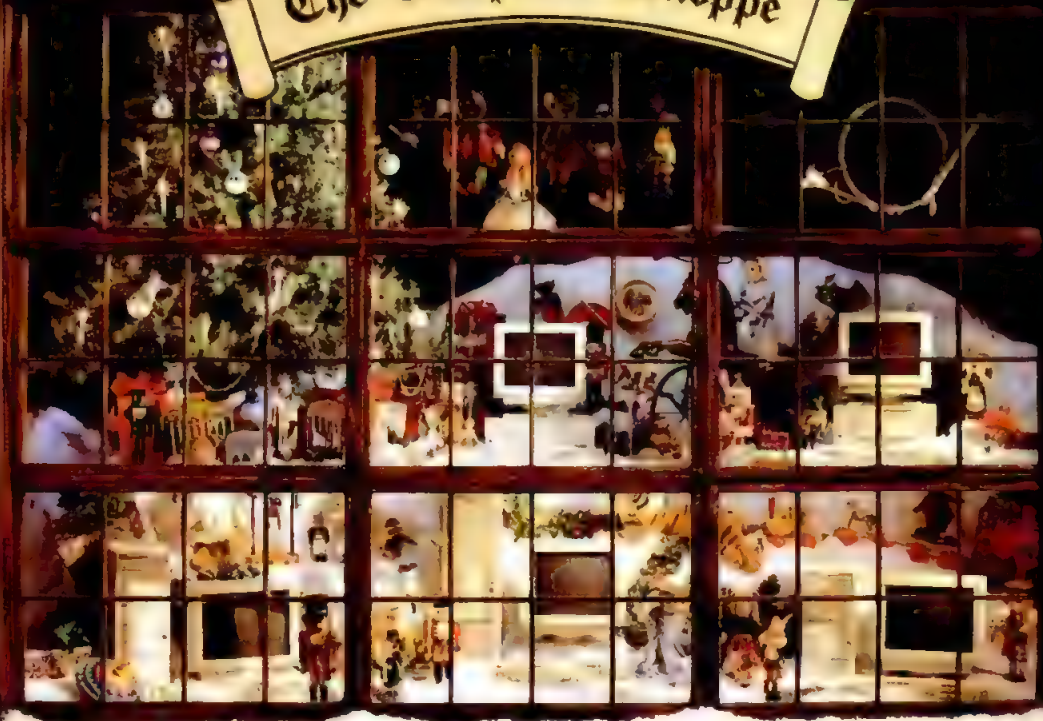
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- ▶ Microsoft Works for Windows 3.0
- ▶ Lotus Organizer
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- ▶ Carrying Case
- ▶ One Year Manufacturer's Warranty

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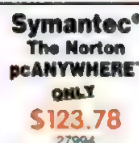
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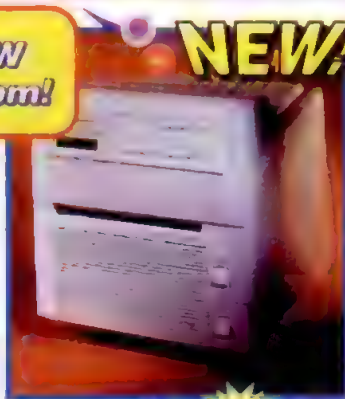


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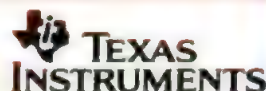
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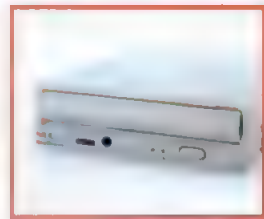


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```

.....
* PROCEDURE Edithelp                                FoxPro for MS-DOS 2.6
* Locates the currently selected topic (SET TOPIC TO) in the help file
* that you specify and lets you edit the help text. If the topic
* doesn't exist in the help file, a browse window is shown and the
* name of the topic is displayed. If no topic is set, only the browse
* window appears.
*
* Suggested usage: Attach to hotkey with:
*   ON KEY LABEL ALT-H DO EDITHELP WITH "HELPPFILE"
.....
PROCEDURE EDITHELP
PARAMETER HELPPFILE
cAlias=ALIAS()      && Save the current work area, to restore later
SET HELP OFF        && Turn help off before opening the help file
SELECT 0            && Select an available work area
USE (helpfile)      && Open the helpfile

* Get the current help topic and search for it in the helpfile
cTopic = SET("TOPIC")
LOCATE FOR TOPIC = cTopic

IF !FOUND() OR EMPTY(cTopic)

```

```

IF !EMPTY(cTopic)  && If the topic is not in the helpfile yet
  WAIT WINDOW NOWAIT "Current Topic: "+cTopic
ENDIF

* Browse the helpfile
DEFINE WINDOW HELPTOPICS FROM 3,10 TO 20,70 ;
  SYSTEM COLOR SCHEME 10 SHADOW FLOAT MINIMIZE
ACTIVATE WINDOW HELPTOPICS
BROWSE FIELDS DETAILS, TOPIC
RELEASE WINDOW HELPTOPICS

IF !      && Topic was found, edit the help text
  MODIFY MEMO details
ENDIF

IF !      && Close the help file
IF !EMPTY(cAlias)
  SELECT (cAlias)  && Restore the work area
ENDIF

SET HELP ON
SET HELP TO (helpfile) && Set help back on
RETURN

```



Figure 3: This program lets you quickly edit the appropriate help text when you're constructing the help file for your Microsoft FoxPro for DOS apps.

cation development is the creation of help files.

Writing the help text related to each screen is a tedious process at best and a nightmare at worst, especially if the application changes and you don't stay on top of the help text. To make this easier, I use the Edithelp function shown in Figure 3 to simplify the creation and maintenance of my help-file text. You can either attach the routine to a hotkey by using the command

```
ON KEY LABEL ALT-H DO EDITHELP WITH
  "HELPPFILE"
```

or attach it to a development menu pad on the system menu. This way, you can edit the current help topic (previously set by SET TOPIC TO <helptopic>) with the press of a button. If the topic exists, an editing window appears so I can modify the help text. One of the advantages of this approach is that I can see my application's screen by moving the editing window. This makes it easier to describe what the user should see and what actions are available.

If the topic doesn't exist in the help file, a Browse window opens, allowing me to choose from the existing help topics or add a new topic by pressing Ctrl-N and then populating the new record. The current setting of SET TOPIC TO is also displayed if a topic is active. Thus I can edit topics or add new topics on the fly. Then the only work left to do is to plant the appropriate SET TOPIC TO commands into the code.

A few notes on help files: The help file is a regular FoxPro database file, but as

soon as the help system uses it, you can no longer edit it. If you issue a

```
USE <helpfile> AGAIN
```

command, you'll be able to view the help file, but just for read-only access. In order to make changes to the help file, you have to turn off the help system and open (USE) the help file directly for editing. Once you're finished editing, the help system must be turned back on.

*Rick Strahl
Concord, California*

► **PC MAGAZINE:** FoxPro for DOS developers will find this an interesting approach to developing their applications' help text. Microsoft FoxPro for Windows developers who ship .DBF-style help files instead of Windows-style help files will also find it useful.

When you call the help system in FoxPro, either by executing the HELP command, pressing F1, or by selecting Help from the system menu, FoxPro automatically searches for the help record that matches the topic specified by the SET TOPIC TO command. Of course if you haven't issued a SET TOPIC TO command, there won't be any topic to search for, and so FoxPro will display the first help record.

The simplest way to add on-line help to your FoxPro for DOS application is to create a help file in FOXHELP.DBF format. This is a table that has a 30-character field named TOPIC that contains the help topic, a memo field named DETAILS that holds the help text, and a 20-character field named CLASS that Fox-

Pro uses to classify the help topics. The third field is optional when you create your own help file. After creating the help file, populate its records with the appropriate topic names and help text. Then, at the beginning of your application code, you include a SET HELP TO command specifying the name of your help file. To make your help text context-sensitive, you sprinkle SET TOPIC TO commands liberally throughout your application logic. For example, if you want the help text for the POSTING topic displayed whenever the user requests help while working with the posting screen, you should issue a

```
SET TOPIC TO POSTING
```

command just prior to executing the code that displays the posting screen.

Mr. Strahl's routine assumes you have set up your application this way, with the appropriate SET TOPIC TO commands scattered throughout. Then you can issue the

```
ON KEY LABEL ALT-H DO EDITHELP WITH
  "HELPPFILE"
```

command from the Command window, using the name of your help file instead of HELPPFILE. After this, you can run your application as you normally would or step through it using the Trace window, and then you can call up the Edithelp routine at the appropriate points in your application in order to write the help text.

For more information on creating a help system for your FoxPro application, see the "Customizing Help" section in the

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FoxPro Developer's Guide.

The Edithelp routine can be downloaded from PC MagNet's Utilities/Tips Forum. Look for the file EDITHE.PRG in the Spreadsh/DBMS section.

—Sal Ricciardi

■ GRAPHICS

Printing PostScript Without a PostScript Printer

❓ My company logo was created by a graphic artist who works with a Macintosh and Adobe Systems' Adobe Illustrator for Windows, Version 5.0. He gave me the file in Encapsulated PostScript (EPS) format. I thought I'd be able to use this file in Microsoft Word For Windows, Version 6.0 and Microsoft Excel, Version 5.0 because both programs support EPS files. But when I bring the file into my document, it just displays as a box with the following message:

Title: (Computer Concepts Logo)

Creator: Adobe Illustrator (TM) 5.0

CreationDate: (4/6/94) (2:48 PM)

What is the problem here? Also, the printer I use is Hewlett-Packard's HP DeskJet 500, which is not a PostScript printer. Although I can convert my EPS file to bitmap format, the logo doesn't look good when printed as a bitmap. Do you know if there is a way to convert this EPS file into something that will preserve the PostScript quality of the image when it's printed?

Steven Rittmeyer
Batesville, Indiana

❓ I'd like to be able to print PostScript files from Windows or DOS on a LaserJet printer. Is there any simple way to do this?

Dick Johan
via CompuServe

► **PC MAGAZINE:** These two questions deal with similar problems in that the Encapsulated PostScript (EPS) format is a subset of the PostScript page description language. The key word here is *language*—PostScript is a programming

language. In order to print any kind of PostScript image, the code must be processed by a PostScript interpreter that is normally built into the printing device.

Microsoft Word for Windows and Microsoft Excel handle the EPS file exactly as Adobe Systems (the developer of PostScript) intended: These programs don't actually read the PostScript code, they merely pass it along to the printing device. The only information they read and subsequently display is the header information of the EPS file.

It's possible to include a preview image in the EPS header. This low-resolution bitmap picture is useful for positioning purposes. Mac-based programs, such as Adobe Illustrator for Windows, Version 5.0, typically include PICT images in the header, while PC-based programs include TIF images in the header. In this particular case, the artist made the wise decision to omit the preview image, because it could cause compatibility problems. Without a preview image to display, Word and Excel simply show a simple gray box to indicate the picture's size. In addition, they display identifying information, such as the filename and the name of the program that generated the picture. But be assured: Behind that simple gray box is all of the PostScript code needed to print your logo.

If you are using your desktop printer to proof files that will ultimately be sent to a service bureau, if you want to print complex drawings, or if you intend to print long documents using Type 1 fonts, the best idea is to upgrade to a PostScript-capable printer. For example, downloading Type 1 fonts to your printer (instead of rasterizing them and sending them to the printer as bitmaps) can result in much faster print times. There is no upgrade path for the HP DeskJet 500, but most printers in HP LaserJet series (starting with the HP LaserJet II) can be upgraded to PostScript. The price will vary depending upon the specific printer model and the amount of memory you add. If you'd like more information, contact Hewlett-Packard's customer service department at 800-752-0900.

You can also use software to convert PostScript code into a different printer control language or into a different graph-

ics file format. Zenographics' ZScript (\$99 direct, 800-366-7494) can translate PostScript code (including EPS files) into the Windows GDI (Graphics Device Interface) format. The GDI information can then be sent to any Windows-compatible output device—including both HP printers mentioned above. Though ZScript is a Windows-based utility, you can also use it to print PostScript files generated with DOS-based programs. If you are running the DOS programs from a Windows shell, you can print interactively; ZScript will capture the output and print it through Windows in the background. Or you can save the PostScript printer files to disk and load them into ZScript's batch processor when you return to Windows.

Even more impressively, ZScript will let you send the GDI data to a preview window instead of directly to the printer. And once you're in the preview window you can use the Clipboard to cut and paste your logo to any other Windows application. You can also save the preview to disk as a standard Windows metafile (WMF). Because the WMF format contains vector information (similar but not identical to the EPS format), it will not exhibit any of the artifacts—like jaggies—associated with bitmap formats. Lines will be smooth, and the file can be resized without degrading image quality.

Converting an EPS file into a WMF file isn't a great option for complex drawings—the Windows Metafile format isn't as robust as the PostScript language. But your company logo, which consists of a few simple shapes and text, should represent no translation problems. One potential pitfall concerning text formatting does exist: If the EPS file references a font that is not installed on your system, the font in your logo could be replaced with a less appropriate one. For example, Windows usually substitutes Helvetica (or Arial) for any Sans Serif font. If you encounter this problem when you convert from the EPS format to the WMF format, have the artist open the original document, convert the text to curves, and reexport the EPS file. When converted to curves, the text behaves exactly like a drawn object and should translate perfectly.

—Luisa Simone

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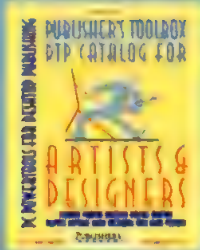
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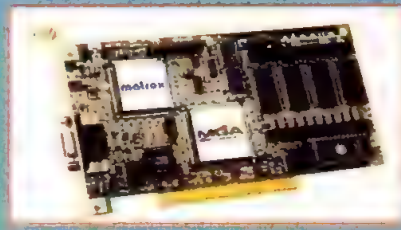
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DeskJet 320
Optional sheet feeder

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LaserJet 4MP

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- ▲ Auto switching between Mac and PC environments
- ▲ 1-Year Warranty

LaserJet 4MP \$1379.99

DeskJet 1200C/PS

- ▲ 45 scalable fonts w/Adobe Postscript Level 2
- ▲ 4MB memory expandable to 20MB
- ▲ 1-Year Warranty

DeskJet 1200C/PS \$1969.99

DeskJet 1200C

- ▲ Sharp, 600x300 "laser-like" print quality with ColorSmart
- ▲ 2MB memory expandable to 26MB
- ▲ 180-sheet paper tray
- ▲ 1-Year Warranty

DeskJet 1200C \$1349.99



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- ▲ 10.4" active matrix color display
- ▲ 1 Type II and 1 Type III PCMCIA slots
- ▲ Accupoint integrated pointing device
- ▲ MS-DOS 6.22, Windows for Workgroups 3.11, Windows Sound System 2.0, Indeo Video, and Runtime Video for Windows

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T4700 and T4800

- ▲ 8MB RAM expandable to 24MB
- ▲ Brilliant 9.5" color display with local bus video
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Microsoft Sound System, built-in microphone, audio out port
- ▲ MS-DOS, UltraFont, Indeo video compression software, Windows for Workgroups 3.11

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	9.5" Active	200MB	\$4549
T4700	486DX2/50	9.5" Active	320MB	\$4899
T4800	486DX4/75	9.5" Active	500MB	\$5599

Lease for \$166/mo.



T4700

Satellite Notebooks

- ▲ 4MB RAM expandable to 20MB
- ▲ 9.5" display
- ▲ 1 Type III (T1900), 1 Type II and 1 Type III (T2400) PCMCIA slot
- ▲ 82-key keyboard
- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse with Quickport (T1900)
- ▲ Accupoint pointing device (T2400)
- ▲ Enhanced power management

Model	Processor	Screen	Hard Drive	Price
T1910	486SX 33	9.5" Mono	200MB	\$1499
T1910	486SX/33	9.5" Dual scan	200MB	\$2039
T1960	486DX2 50	9.5" Dual scan	200MB	\$2379
T1960	486DX2/50	9.5" Dual scan	320MB	\$2629
T1960	486DX2/50	8.4" Active	200MB	\$3029
T1960	486DX2/50	8.4" Active	320MB	\$3259
T2400	486DX2/50	9.5" Dual Scan	250MB	\$2929
T2400	486DX2/50	9.5" Dual Scan	320MB	\$3089
T2400	486DX2/50	8.4" Active	250MB	\$3639
T2400	486DX2/50	8.4" Active	320MB	\$3799

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T1910

Portégé

- ▲ Ultra-portability at only 4.1 lbs.
- ▲ 4MB RAM, expandable to 20MB
- ▲ PCMCIA Type II slot
- ▲ External 3.5" disk drive
- ▲ Integrated AccuPoint pointing device

Model	Processor	Screen	Hard Drive	Price
T3400CT	486SX33	7.8" Active	250MB	\$2899
T3600CT	486DX2/50	8.4" Active	250MB	\$4069

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T3400

TOSHIBA



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\$449.99

Model	Description	Price
XJ1144	14.4/14.4 XJACK	\$199.99
CC3144	14.4/14.4 PCMCIA	\$199.99
XJ2144	14.4/14.4 XJACK GOLD	\$249.99
CC4144	14.4/14.4 PCMCIA GOLD	\$249.99
XJ2288	28.8/14.4 XJACK	\$449.99
CC3288	28.8/14.4 PCMCIA	\$449.99

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Stylus Color 140CPS 72dpi with special paper \$599.99
Stylus Color 130CPS 36dpi 100 Sheets \$399.99
Aimless Laser 1500 6PPM 4000 \$699.99
Aimless Laser 1600 6PPM 6000 \$999.99

Magnavox

14" SVGA 1024x768ni 28mm	\$279.99
15" SVGA 1024x768ni 28mm	\$309.99
15" SVGA 1280x1024ni 28mm	\$399.99
17" SVGA 1024x768ni 31mm	\$599.99
20" SVGA 1280x1024ni 31mm	\$1089.99

Magnavox 15" SVGA 1024x768ni

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Energy Star



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\$219.99

Other Models Available



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\$149.99



Artisoft

LANTastic V6 0- Starter Kit	\$229.99
LANTastic V6 0- 1 User	\$79.99
LANTastic V6 0- 5 User	\$329.99
Node Runner S- 2000C	\$74.99
Eagle NE200T PCMCIA Ethernet	\$199.99

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Computer Model	4MB	8MB
Toshiba T4700 T4800	\$249.99	\$489.99
Toshiba T1910	\$204.99	\$439.99
IBM ThinkPad 360	\$209.99	\$439.99
NEC 9801	\$209.99	\$439.99
Asi Ascendia 900	\$219.99	\$499.99

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MiniStor 340MB Drive PCMCIA Type III	\$439.99
Direct Socket PCMCIA Drive Bay Adapter	\$99.99
260MB Drive PCMCIA III w/ Dockit Socket	\$399.99

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- ▲ 486DX2/50 or 486DX4/75 processor
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- ▲ PCMCIA Type III slot

Model	Screen	Hard Drive	Price
4/50 Model 343W	10.3" Dual scan	340MB	\$2719
4/50 Model 343W	9.5" Active	340MB	\$4149
4/75 Model 343W	10.3" Dual scan	340MB	\$3219
4/75 Model 513W	10.4" Active	510MB	\$5029

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Ascentia 900N

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New Generation!

- ▲ 4/8MB RAM exp. to 64MB
- ▲ VESA local bus graphics
- ▲ 1MB video RAM
- ▲ MS-DOS 6.2, Windows 3.1
- ▲ Energy Star Compliant

Model	RAM	Hard Drive	Price
4/33s Model 273W	8MB	270MB	\$1369
4/50s Model 273W	8MB	270MB	\$1439
4/66d Model 273W	8MB	270MB	\$1699
4/66d Model 543W	8MB	540MB	\$1829
4/100t Model 273W	8MB	270MB	\$2149
4/100t Model 543W	8MB	540MB	\$2189

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AST Advantage! Adventure Multimedia

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- ▲ 16-Bit Creative Labs Soundblaster
- ▲ 14.4 Send/Receive Fax modem w/telephone answering
- ▲ Over 17 software titles
- ▲ 3-Year Warranty

Processor	Hard Drive	Price*
486DX2/50	540MB	\$1349
486DX2/66	420MB	\$1499
486DX2/66	420MB	\$1589
Pentium 60Mhz	540MB	\$1999

Lease for \$50/mo.

*AST Color Monitors start at \$369.99

Ascentia 800N

- ▲ 486SX/33 or DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 9.5" dual scan color display
- ▲ PCMCIA Type III slot

Model	Hard Drive	Price
4/33s Model 253W	250MB	\$2099
4/33s Model 343W	340MB	\$2259
4/50d Model 253W	250MB	\$2349
4/50d Model 343W	340MB	\$2499

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Bravo MS Desktops Extra Performance

- ▲ 8/16MB RAM expandable to 128MB
- ▲ 64-bit PCI local bus graphics
- ▲ Enhanced IDE controller-supports 4 devices
- ▲ Energy Star compliant

Processor	RAM	Hard Drive	Price
486SX2/50	8MB	270MB	\$1659
486SX2/50	8MB	540MB	\$1779
486DX2/66	8MB	270MB	\$1939
Pentium 60Mhz	8MB	420MB	\$2399
Pentium 100Mhz	8MB	420MB	\$3569

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High-end features at a low-end price!

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- ▲ Modular design with removable hard drive & floppy drive
- ▲ 32-bit VESA local bus graphics, 512KB video RAM
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ Modem/audio module available
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- ▲ Built-in AC adapter
- ▲ MS DOS, Windows 3.1 and CoSession Host software
- ▲ 1-Year Z-CARE on-site service

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	9.5" mono	200MB	\$1699
486DX2/50	4MB	9.5" dual scan	200MB	\$2179
486DX2/50	8MB	9.5" dual scan	340MB	\$2549
486DX2/50	4MB	9.5" active	340MB	\$3309

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\$1699



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- ▲ Detachable video display
- ▲ Built-in 16-bit stereo sound with speaker and microphone
- ▲ Integrated trackball
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ MS-DOS, Windows for Workgroups, Microsoft Sound System
- ▲ 3-Year Warranty

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	10.3" dual scan	200MB	\$2869
486DX2/50	4MB	10.3" dual scan	340MB	\$3149
486DX2/50	4MB	9.5" active	340MB	\$4339
486DX2/50	8MB	9.5" active	450MB	\$4759
486DX4/75	8MB	9.5" active	520MB	\$5339

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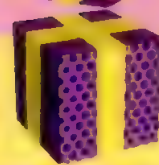
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Z-NOTEFLEX ACCESSORIES

FLEXDOCK port replicator	\$219.99
FLEXBAY floppy bay/battery recharger	\$159.99
FLEXSHOW Multimedia Companion	\$799.99
FLEXSITE LCD display stand	\$199.99

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Versa V

- ▲ 486DX2/50
- ▲ 4MB expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball
- ▲ Removable hard drive
- ▲ Removable floppy – add second battery

Screen	Hard Drive	Price
9.5" Dual scan	250MB	\$2839
9.5" Active	250MB	\$3619
9.5" Active	340MB	\$3799
9.5" Active	540MB	\$4279

Lease for \$104/mo.

Versa M

- ▲ 486DX4/75 or 486DX4/100 processor
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Removable hard drive
- ▲ Removable screen
- ▲ Integrated speaker, microphone
- ▲ MS-DOS, Windows 3.1, Windows Sound System, Video for Windows RunTime

Processor	Hard Drive	Screen	Price
486DX4/75	340MB	Dual Scan	\$3899
486DX4/75	540MB	Active	\$5199
486DX4/100	810MB	Active	\$6049
486DX4/75	540MB	High Res. Active	\$5579
486DX4/100	810MB	High Res. Active	\$6429
486DX4/75	340MB	True Color Active	\$5099

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Versa S

- ▲ 486 processor
- ▲ 9.5" screen
- ▲ SurePoint integrated pointing device
- ▲ 2 Type II PCMCIA slots
- ▲ Only 4 lbs.

Processor	Screen	Hard Drive	Price
486SX 33	9.5" Mono	210MB	\$1699
486SX 33	9.5" Dual Scan	210MB	\$1889
486SX 33	9.5" Active	210MB	\$2839
486DX2 50	9.5" Active	260MB	\$3299

Lease for \$62/mo.

Ready Multimedia Desktops

- ▲ 486 processor
- ▲ VESA local bus graphics
- ▲ NEC CD-ROM drive
- ▲ SoundBlaster 16 sound card
- ▲ Speakers, microphone
- ▲ 24/96 fax modem
- ▲ MS-DOS, Windows, Quicken
- ▲ CD titles: Compton's Encyclopedia, PFS Window Works

Processor	Hard Drive	Price*
486SX 33 desktop	270MB	\$1299
486DX2/66 desktop	340MB	\$1539
486DX2/66 minitower	420MB	\$1639

*NEC monitors start at \$339.99
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- ▲ MPRII, Energy Star
- ▲ OSM, Monitor Manager software

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XE21, 1280x1024ni, 28mm	\$1999 99

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Kit and Microsoft Encarta included **\$179.99**

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speakers, batteries, the best-selling titles
MYST and SimCity, and the MultiSpin 2V
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PCMCIA



MobileMax 131

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Maxtor

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546MB IDE Drive, Enhanced Kit	\$299 99
131MB PCMCIA Drive, Type III	\$339 99
171MB PCMCIA Drive, Type III	\$389 99

Sony

Trinitron Multiscan Monitors	
15" SVGA, 1280x1024ni, 25mm	\$ 449 99
17" SVGA, 1024x768ni, 23mm	\$ 939 99
17" SVGA, 1600x1280ni, 23mm	\$ 979 99
20" SVGA, 1600x1280ni, 30mm	\$1889 99

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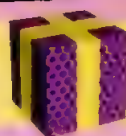
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- ▲ IBM 486BL2/50 processor
- ▲ 4MB RAM exp. to 20MB
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- ▲ Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ Weighs only 3.8 lbs.
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0

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- ▲ PCMCIA capable
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ThinkPad 360® Notebooks

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- ▲ Modular design, removable hard drive & floppy drive
- ▲ Local Bus Graphics with 1MB video RAM
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0
- ▲ Port Replicator and Docking Station available

Screen	Hard Drive	Price
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9.5" Monochrome	340MB	\$2229
9.5" Dual Scan	170MB	\$2279
9.5" Dual Scan	340MB	\$2659
8.4" Active Color	170MB	\$2719
8.4" Active Color	340MB	\$3099

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- ▲ Removable hard drive
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Integrated trackball
- ▲ MS-DOS 6.0, Windows 3.1, MS Video for Windows Runtime

Processor	Display	Hard Drive	Price
486DX2/40	9.5" Dual scan	170MB	\$3119
486DX2/40	8.4" Active	170MB	\$3779
486DX2/40	8.4" Active	340MB	\$4159
486DX2/50	9.5" Mono	250MB	\$3299
486DX2/50	9.5" Active	340MB	\$4999
486DX4/75	9.5" Active	340MB	\$5669
486DX4/75	9.5" Active	510MB	\$6139

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LTE Elite



Contura 400

- ▲ 486DX2/40 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Large built-in trackball
- ▲ MS-DOS, Windows 3.1, Tabworks, Lotus Organizer

Display	Hard Drive	Price
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8.4" Active	250MB	\$3119

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- ▲ 3.5" floppy drive
- ▲ Local bus graphics
- ▲ Pentium upgradable
- ▲ Energy Star compliant
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive	Price
486SX/33	4MB	200MB	\$1049
486SX2/50	4MB	200MB	\$1169
486DX2/66	4MB	340MB	\$1489
486DX2/66	4MB	525MB	\$1639
486DX4/100	8MB	340MB	\$1999
486DX4/100	8MB	525MB	\$2139

*COMPAQ color monitors start at \$259.99

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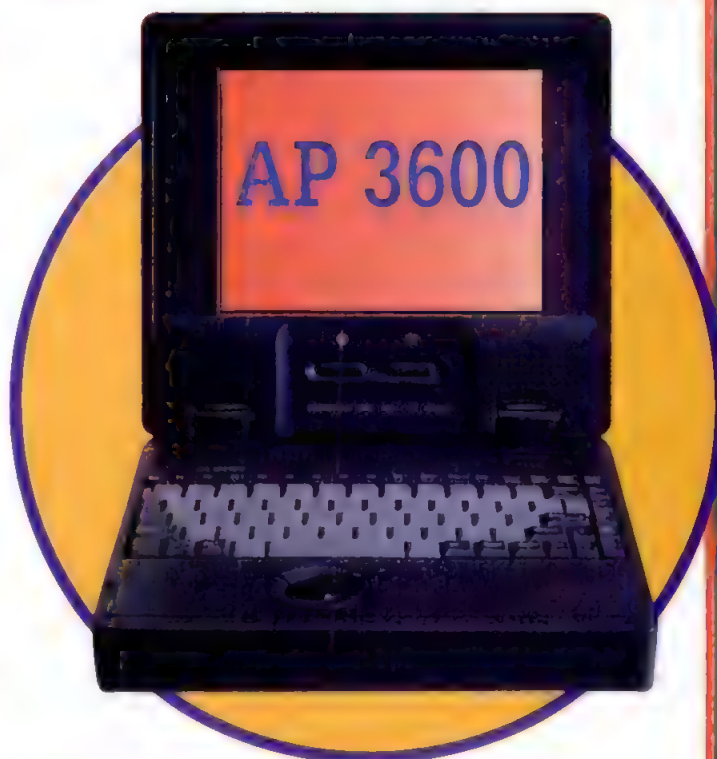
486DX-4

- Intel 486 upgradeable CPU
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- Microprocessor System
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- 11.14" W x 8.66" D x 1.97" H

AP 3600

Pentium

- Intel Pentium™ 60/66 MHz CPU
- 32 MB VRAM (up to 64 MB)
- 1 MB cache RAM
- PMMA 11" x 7" BNC
- 80000 Active Cells
- Microprocessor System
- 3200-Docking Cable
- 8 MB RAM expandable to 40MB
- 3.5" 1.44 MB Floppy Drive
- 9.5" Mono & Active Matrix LCD
- 10.3" Dual Scan LCD
- Simultaneous LCD & CRT Display
- Built-in 25mm Trackball
- NiMH Battery (46 Watts)
- 11.14" W x 8.66" D x 1.97" H
- Ports for Ext. Keyboard, Ext. VGA Monitor, & 200 Pin Connector for Docking Station
- Microsoft DOS 6.22
- 8.15lbs. with Battery
- 11.14" W x 10.31" D x 2.56" H



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AP 3600/Pentium-66		\$2975	\$3775
AP 9200/486SX-33	\$1595	\$2095	\$2895
AP 9200/486DX-33	\$1695	\$2195	\$2995
AP 9200/486DX2-66	\$1745	\$2245	\$3045
AP 9200/486DX4-100	\$2095	\$2595	\$3395



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SystemPro IZ Series, ProSignia PC Server 486/33, DX2/66

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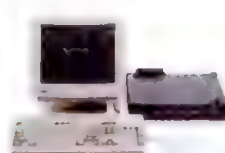
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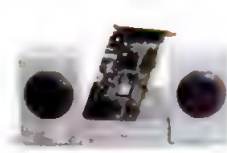
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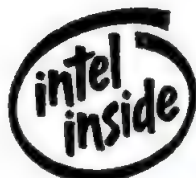
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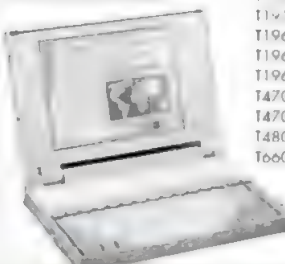


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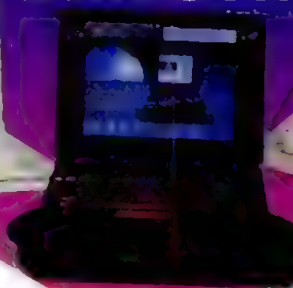
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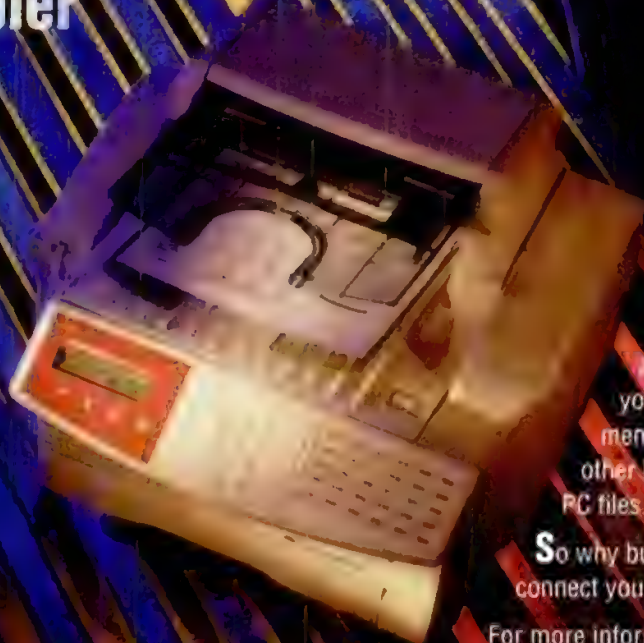
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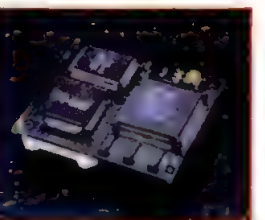
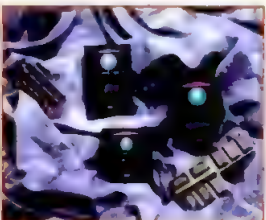
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- (2) high speed serial ports
- Bi-directional parallel port and game port
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- (2) high speed serial ports
- Bi-directional parallel port and game port
- 2X CD-ROM drive, 3.5" floppy drive
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- VESA Local-BUS graphics card with 1MB
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- Bi-directional parallel port and game port
- 2X CD-ROM drive, 3.5" floppy drive
- 16-bit sound card and speakers
- VESA Local-BUS graphics card with 1MB
- 15" SVGA Monitor, Non-Interlaced, .28dp, digital controls, Energy Star Compliant
- Microsoft Mouse, Honeywell 101 keyboard
- MS-DOS 6.22 & Windows for Workgroups
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- Transporter Menu System
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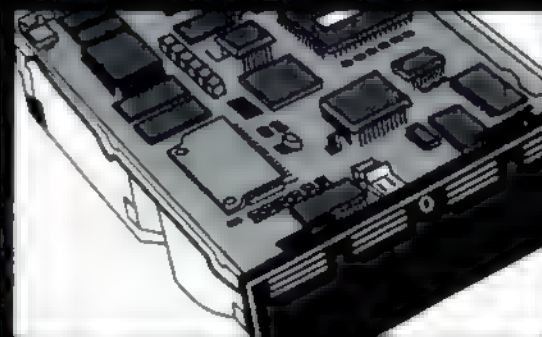
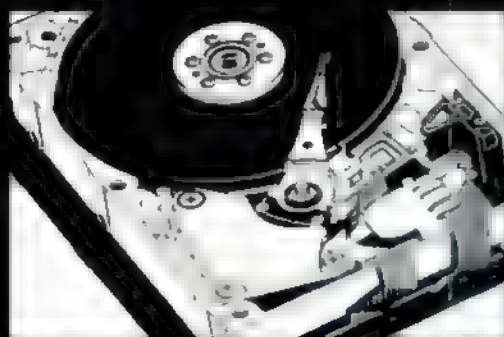
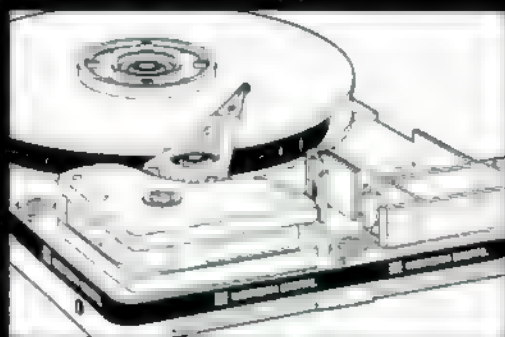


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420MB	14ms	CFS420A	\$205
850MB	10ms	CNR850A	\$419
1275MB	9ms	CNR1275A	\$539

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540MB	12ms	M7540AV	\$259

MICROPOLIS

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1740MB	10ms	MC2217A	\$889
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2050MB	8.5ms	MC4221	\$1399
3020MB	11ms	MC1936	\$1659
4294MB	8ms	MC3243	\$2279
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1000MB	10ms	MC4110AV	\$639
1700MB	10ms	MC2217AV	\$989
2000MB	8.5ms	MC4221AV	\$1469
3000MB	11ms	MC1936AV	\$1699
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341MB	13ms	ST3391A	\$193
420MB	14ms	ST3491A	\$205
545MB	12ms	ST5660A	\$259
722MB	12ms	ST3780A	\$375
1083MB	12ms	ST31220A	\$495
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2145MB	8ms	ST12550N	\$1219
2148MB	9ms	ST12400N	\$1090
4290MB	9ms	ST15230N	\$1889
4290MB	8ms	ST15150N	\$2199
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342MB	12ms	LPS340A	\$199
541MB	12ms	LPS540A	\$252
SCSI			
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270MB	12ms	LPS270S	\$189
342MB	12ms	LPS340S	\$215
541MB	12ms	LPS540S	\$265
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1440MB	9.5ms	IMP1440S	\$749
2160MB	9.5ms	IMP2160S	\$999

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XM3501	\$569
PX43CH	\$599
PRO	\$409
SB	\$289
SA	\$449
CD50	\$485
XM3401	\$549
CDR510	\$569
XM3501	\$689
PX43CH	\$729

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A1542CBASIC 16Bit SCSI	\$239	\$215
A2742 EISA SCSI	\$359	\$349
A2842 VESA SCSI	\$259	\$249
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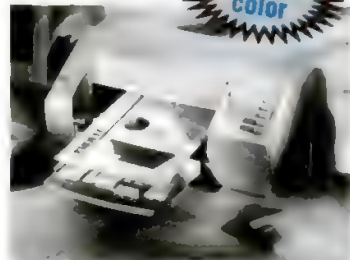
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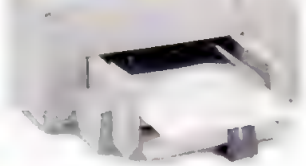
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EVX75CS4/3

486 DX4/75 Active Matrix Color

8MB RAM, 340MB HDD. **\$3,589**
EVX75CS8/3

486 DX4/75 Active Matrix Color

8MB RAM, 514MB HDD. **\$3,939**
EVX75CS8/5

486 DX4/75 Active Matrix Color

4MB RAM, 120MB HDD. **\$1,949**
EVX33CS4/1



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Z-Star EX

Cx486DX2/50MHz w/coprocessor
4MB RAM, 200MB Hard Drive,
Monochrome

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Cx486DX2/50MHz w/coprocessor,
8MB RAM, 200MB Hard Drive,
Monochrome

ZNS50M/3 1,899

Cx486DX2/50MHz

w/coprocessor
8MB RAM, 340MB Hard Drive,
Dual Scan Color

ZNS50CS/2 2,499

Cx486DX2/50MHz

w/coprocessor
4MB RAM, 340MB
Hard Drive, Active Matrix Color

ZNS50CT4/3 3,249

Cx486DX2/50MHz w/coprocessor
8MB RAM, 340MB Hard Drive,
Active Matrix Color

ZNS50CT8/3 3,529

Cx486DX2/50MHz w/coprocessor
4MB RAM, 200MB Hard Drive,
Dual Scan Color

ZNS50CS4/2 2,139



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486DX4/75MHz
8MB RAM, 200MB Hard Drive,
Dual Scan color

ZNF75CT8/5 \$5,179

486DX2/50MHz, 4MB RAM, -
200MB Hard Drive, Dual Scan color

ZNF50CS4/2 2,779

486DX2/50MHz, 4MB RAM,
340MB Hard Drive, Active color

ZNF50CT8/4 4,599

486SX/33MHz, 4MB RAM,
200MB Hard Drive, Dual Scan color

See our complete product listing across from "After Hours!"



CP60p Desktop



CP60p Mini-Tower

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Greater Value.***

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- └ Lifetime BBS Support
- └ Onsite Installation Option
- └ Free CompuAdd System Configuration



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	CP60p Desktop	CP60p Mini-Tower*	CP90p Mini-Tower*	CP90p Tower
CPU	Intel 60MHz Pentium	Intel 60MHz Pentium	Intel 90MHz Pentium	Intel 90MHz Pentium
RAM	8MB	8MB	8MB	16MB
Cache	256KB	256KB	256KB	256KB
Hard Drive	212MB	420MB	420MB	1GB
Expansion	8 Slots, 3 with PCI	8 Slots, 3 with PCI	8 Slots, 3 with PCI	8 Slots, 3 with PCI
Monitor	14" N-I	15" N-I	15" N-I	14" N-I
Video	1MB PCI	1MB PCI	1MB PCI	1MB PCI
CD ROM	Optional	Dual Speed MPC2 Compliant	Dual Speed MPC2 Compliant	Dual Speed MPC2 Compliant
Fax/Modem	No	Yes	Yes	No

All 4 Systems Include: 101-key Keyboard, Microsoft Mouse, 3.5" Floppy, MS DOS 6.2, Windows for Workgroups 3.11, CompuServe Starter Kit... and More!

Price	\$2,195	\$2,299	\$2,599	\$3,795
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[illegible]

PS/2 CL575X and ThinkPad 700	4
700c, 720, 720c, 755	8
ThinkPad 710T	8
	8
MSI Notebook (All)	28
	4
1405X, N333X, PS/Mini 182	4

386/486X PROCESSOR UPGRADES

Upgrade Type	Approx. Performance Increase
Standard 386SX CPU	5
With 486 CPU	14.5
With 486 CPU & Tripler Upgrade	20

486/586 PROCESSOR UPGRADES

Upgrade Type	Approx. Performance Increase
Standard 486SX CPU	5
With 486 CPU	14.5
With 486 CPU & Tripler Upgrade	40.5

INCREASE 500% PERFORMANCE

Source: Intel Performance Comparison Charts. Performance based on SPECintbase rate. All upgrades are based on a 386SX CPU.

[illegible]

4400, T6400 (all models)

Z-Sport 420S, 425S
MastersPort 384SL, SLC, SLs
Z-Star

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8MB	581159-005	5709	581159-006
16MB	581159-007	5709	581159-008
32MB	581159-009	5709	581159-010
64MB	581159-011	5709	581159-012
128MB	581159-013	5709	581159-014
256MB	581159-015	5709	581159-016
512MB	581159-017	5709	581159-018
1GB	581159-019	5709	581159-020
2GB	581159-021	5709	581159-022
4GB	581159-023	5709	581159-024
8GB	581159-025	5709	581159-026
16GB	581159-027	5709	581159-028
32GB	581159-029	5709	581159-030
64GB	581159-031	5709	581159-032
128GB	581159-033	5709	581159-034
256GB	581159-035	5709	581159-036
512GB	581159-037	5709	581159-038
1TB	581159-039	5709	581159-040
2TB	581159-041	5709	581159-042
4TB	581159-043	5709	581159-044
8TB	581159-045	5709	581159-046
16TB	581159-047	5709	581159-048
32TB	581159-049	5709	581159-050
64TB	581159-051	5709	581159-052
128TB	581159-053	5709	581159-054
256TB	581159-055	5709	581159-056
512TB	581159-057	5709	581159-058
1PB	581159-059	5709	581159-060
2PB	581159-061	5709	581159-062
4PB	581159-063	5709	581159-064
8PB	581159-065	5709	581159-066
16PB	581159-067	5709	581159-068
32PB	581159-069	5709	581159-070
64PB	581159-071	5709	581159-072
128PB	581159-073	5709	581159-074
256PB	581159-075	5709	581159-076
512PB	581159-077	5709	581159-078
1TB	581159-079	5709	581159-080
2TB	581159-081	5709	581159-082
4TB	581159-083	5709	581159-084
8TB	581159-085	5709	581159-086
16TB	581159-087	5709	581159-088
32TB	581159-089	5709	581159-090
64TB	581159-091	5709	581159-092
128TB	581159-093	5709	581159-094
256TB	581159-095	5709	581159-096
512TB	581159-097	5709	581159-098
1PB	581159-099	5709	581159-100

COMPAQ			
Desktop 3/25c	33c	4/25c	33c
4MB	116490-001	5101	116490-002
8MB	116490-003	5101	116490-004
16MB	116490-005	5101	116490-006
32MB	116490-007	5101	116490-008
64MB	116490-009	5101	116490-010
128MB	116490-011	5101	116490-012
256MB	116490-013	5101	116490-014
512MB	116490-015	5101	116490-016
1GB	116490-017	5101	116490-018
2GB	116490-019	5101	116490-020
4GB	116490-021	5101	116490-022
8GB	116490-023	5101	116490-024
16GB	116490-025	5101	116490-026
32GB	116490-027	5101	116490-028
64GB	116490-029	5101	116490-030
128GB	116490-031	5101	116490-032
256GB	116490-033	5101	116490-034
512GB	116490-035	5101	116490-036
1TB	116490-037	5101	116490-038
2TB	116490-039	5101	116490-040
4TB	116490-041	5101	116490-042
8TB	116490-043	5101	116490-044
16TB	116490-045	5101	116490-046
32TB	116490-047	5101	116490-048
64TB	116490-049	5101	116490-050
128TB	116490-051	5101	116490-052
256TB	116490-053	5101	116490-054
512TB	116490-055	5101	116490-056
1PB	116490-057	5101	116490-058
2PB	116490-059	5101	116490-060
4PB	116490-061	5101	116490-062
8PB	116490-063	5101	116490-064
16PB	116490-065	5101	116490-066
32PB	116490-067	5101	116490-068
64PB	116490-069	5101	116490-070
128PB	116490-071	5101	116490-072
256PB	116490-073	5101	116490-074
512PB	116490-075	5101	116490-076
1TB	116490-077	5101	116490-078
2TB	116490-079	5101	116490-080
4TB	116490-081	5101	116490-082
8TB	116490-083	5101	116490-084
16TB	116490-085	5101	116490-086
32TB	116490-087	5101	116490-088
64TB	116490-089	5101	116490-090
128TB	116490-091	5101	116490-092
256TB	116490-093	5101	116490-094
512TB	116490-095	5101	116490-096
1PB	116490-097	5101	116490-098
2PB	116490-099	5101	116490-100

DELL			
Power Desktop 3250	3250	3330	3330
4MB	310-2505	539	310-2507
8MB	310-2507	539	310-2509
16MB	310-2509	539	310-2511
32MB	310-2511	539	310-2513
64MB	310-2513	539	310-2515
128MB	310-2515	539	310-2517
256MB	310-2517	539	310-2519
512MB	310-2519	539	310-2521
1GB	310-2521	539	310-2523
2GB	310-2523	539	310-2525
4GB	310-2525	539	310-2527
8GB	310-2527	539	310-2529
16GB	310-2529	539	310-2531
32GB	310-2531	539	310-2533
64GB	310-2533	539	310-2535
128GB	310-2535	539	310-2537
256GB	310-2537	539	310-2539
512GB	310-2539	539	310-2541
1TB	310-2541	539	310-2543
2TB	310-2543	539	310-2545
4TB	310-2545	539	310-2547
8TB	310-2547	539	310-2549
16TB	310-2549	539	310-2551
32TB	310-2551	539	310-2553
64TB	310-2553	539	310-2555
128TB	310-2555	539	310-2557
256TB	310-2557	539	310-2559
512TB	310-2559	539	310-2561
1PB	310-2561	539	310-2563
2PB	310-2563	539	310-2565
4PB	310-2565	539	310-2567
8PB	310-2567	539	310-2569
16PB	310-2569	539	310-2571
32PB	310-2571	539	310-2573
64PB	310-2573	539	310-2575
128PB	310-2575	539	310-2577
256PB	310-2577	539	310-2579
512PB	310-2579	539	310-2581
1TB	310-2581	539	310-2583
2TB	310-2583	539	310-2585
4TB	310-2585	539	310-2587
8TB	310-2587	539	310-2589
16TB	310-2589	539	310-2591
32TB	310-2591	539	310-2593
64TB	310-2593	539	310-2595
128TB	310-2595	539	310-2597
256TB	310-2597	539	310-2599
512TB	310-2599	539	310-2601
1PB	310-2601	539	310-2603
2PB	310-2603	539	310-2605
4PB	310-2605	539	310-2607
8PB	310-2607	539	310-2609
16PB	310-2609	539	310-2611
32PB	310-2611	539	310-2613
64PB	310-2613	539	310-2615
128PB	310-2615	539	310-2617
256PB	310-2617	539	310-2619
512PB	310-2619	539	310-2621
1TB	310-2621	539	310-2623
2TB	310-2623	539	310-2625
4TB	310-2625	539	310-2627
8TB	310-2627	539	310-2629
16TB	310-2629	539	310-2631
32TB	310-2631	539	310-2633
64TB	310-2633	539	310-2635
128TB	310-2635	539	310-2637
256TB	310-2637	539	310-2639
512TB	310-2639	539	310-2641
1PB	310-2641	539	310-2643
2PB	310-2643	539	310-2645
4PB	310-2645	539	310-2647
8PB	310-2647	539	310-2649
16PB	310-2649	539	310-2651
32PB	310-2651	539	310-2653
64PB	310-2653	539	310-2655
128PB	310-2655	539	310-2657
256PB	310-2657	539	310-2659
512PB	310-2659	539	310-2661
1TB	310-2661	539	310-2663
2TB	310-2663	539	310-2665
4TB	310-2665	539	310-2667
8TB	310-2667	539	310-2669
16TB	310-2669	539	310-2671
32TB	310-2671	539	310-2673
64TB	310-2673	539	310-2675
128TB	310-2675	539	310-2677
256TB	310-2677	539	310-2679
512TB	310-2679	539	310-2681
1PB	310-2681	539	310-2683
2PB	310-2683	539	310-2685
4PB	310-2685	539	310-2687
8PB	310-2687	539	310-2689
16PB	310-2689	539	310-2691
32PB	310-2691	539	310-2693
64PB	310-2693	539	310-2695
128PB	310-2695	539	310-2697
256PB	310-2697	539	310-2699
512PB	310-2699	539	310-2701
1TB	310-2701	539	310-2703
2TB	310-2703	539	310-2705
4TB	310-2705	539	310-2707
8TB	310-2707	539	310-2709
16TB	310-2709	539	310-2711
32TB	310-2711	539	310-2713
64TB	310-2713	539	310-2715
128TB	310-2715	539	310-2717
256TB	310-2717	539	310-2719
512TB	310-2719	539	310-2721
1PB	310-2721	539	310-2723
2PB	310-2723	539	310-2725
4PB	310-2725	539	310-2727
8PB	310-2727	539	310-2729
16PB	310-2729	539	310-2731
32PB	310-2731	539	310-2733
64PB	310-2733	539	310-2735
128PB	310-2735	539	310-2737
256PB	310-2737	539	310-2739
512PB	310-2739	539	310-2741
1TB	310-2741	539	310-2743
2TB	310-2743	539	310-2745
4TB	310-2745	539	310-2747
8TB	310-2747	539	310-2749
16TB	310-2749	539	310-2751
32TB	310-2751	539	310-2753
64TB	310-2753	539	310-2755
128TB	310-2755	539	310-2757
256TB	310-2757	539	310-2759
512TB	310-2759	539	310-2761
1PB	310-2761	539	310-2763
2PB	310-2763	539	310-2765
4PB	310-2765	539	310-2767
8PB	310-2767	539	310-2769
16PB	310-2769	539	310-2771
32PB	310-2771	539	310-2773
64PB	310-2773	539	310-2775
128PB	310-2775	539	310-2777
256PB	310-2777	539	310-2779
512PB	310-2779	539	310-2781
1TB	310-2781	539	310-2783
2TB	310-2783	539	310-2785
4TB	310-2785	539	310-2787
8TB	310-2787	539	310-2789
16TB	310-2789	539	310-2791
32TB	310-2791	539	310-2793
64TB	310-2793	539	310-2795
128TB	310-2795	539	310-2797
256TB	310-2797	539	310-2799
512TB	310-2799	539	310-2801
1PB	310-2801	539	310-2803
2PB	310-2803	539	310-2805
4PB	310-2805	539	310-2807
8PB	310-2807	539	310-2809
16PB	310-2809	539	310-2811
32PB	310-2811	539	310-2813
64PB	310-2813	539	310-2815
128PB	310-2815	539	310-2817
256PB	310-2817	539	310-2819
512PB	310-2819	539	310-2821
1TB	310-2821	539	310-2823
2TB	310-2823	539	310-2825
4TB	310-2825	539	310-2827
8TB	310-2827	539	310-2829
16TB	310-2829	539	310-2831
32TB	310-2831	539	310-2833
64TB	310-2833	539	310-2835
128TB	310-2835	539	310-2837
256TB	310-2837	539	310-2839
512TB	310-2839	539	310-2841
1PB	310-2841	539	310-2843
2PB	310-2843	539	310-2845
4PB	310-2845	539	310-2847
8PB	310-2847	539	310-2849
16PB	310-2849	539	310-2851
32PB	310-2851	539	310-2853
64PB	310-2853	539	310-2855
128PB	310-2855	539	310-2857
256PB	310-2857	539	310-2859
512PB	310-2859	539	310-2861
1TB	310-2861	539	310-2863
2TB	310-2863	539	310-2865
4TB	310-2865	539	310-2867
8TB	310-2867	539	310-2869
16TB	310-2869	539	310-2871
32TB	310-2871	539	310-2873
64TB	310-2873	539	310-2875
128TB	310-2875	539	310-2877
256TB	310-2877	539	310-2879
512TB	310-2879	539	310-2881
1PB	310-2881	539	310-2883
2PB	310-2883	539	310-2885
4PB	310-2885	539	310-2887
8PB	310-2887	539	310-2889
16PB	310-2889	539	310-2891
32PB	310-2891	539	310-2893
64PB	310-2893	539	310-2895
128PB	310-2895	539	310-2897
256PB	310-2897	539	310-2899
512PB	310-2899	539	310-2901
1TB	310-2901	539	310-2903
2TB	310-2903	539	310-2905
4TB	310-2905	539	310-2907
8TB	310-2907	539	310-2909
16TB	310-2909	539	310-2911
32TB	310-2911	539	310-2913
64TB	310-2913	539	310-2915
128TB	310-2915	539	310-2917
256TB	310-2917	539	310-2919
512TB	310-2919	539	310-2921
1PB	310-2921	539	310-2923
2PB	310-2923	539	310-2925
4PB	310-2925	539	310-2927
8PB	310-2927	539	310-2929
16PB	310-2929	539	310-2931
32PB	310-2931	539	310-2933
64PB	310-2933	539	310-2935
128PB	310-2935	539	310-2937
256PB	310-2937	539	310-2939
512PB	310-2939	539	310-2941
1TB	310-2941	539	310-2943
2TB	310-2943	539	310-2945
4TB	310-2945	539	310-2947
8TB	310-2947	539	310-2949
16TB	310-2949	539	310-2951
32TB	310-2951	539	310-2953
64TB	310-2953	539	310-2955
128TB	310-2955	539	310-2957
256TB	310-2957	539	310-2959
512TB	310-2959	539	310-2961
1PB	310-2961	539	310-2963
2PB	310-2963	539	310-2965
4PB	310-2965	539	310-2967
8PB	310-2967	539	310-2969
16PB	310-2969	539	310-2971
32PB	310-2971	539	310-2973
64PB	310-2973	539	310-2975
128PB	310-2975	539	310-2977
256PB	310-2977	539	310-2979
512PB	310-2979	539	310-2981
1TB	310-2981	539	310-2983
2TB	310-2983	539	310-2985
4TB	310-2985	539	310-2987
8TB	310-2987	539	310-2989
16TB	310-2989	539	310-2991
32TB	310-2991	539	310-2993
64TB	310-2993	539	310-2995
128TB	310-2995	539	310-2997
256TB	310-2997	539	310-2999
512TB	310-2999	539	310-3001
1PB	310-3001	539	310-3003
2PB	310-3003	539	310-3005
4PB	310-3005	539	310-3007
8PB	310-3007	539	310-3009
16PB	310-3009	539	310-3011
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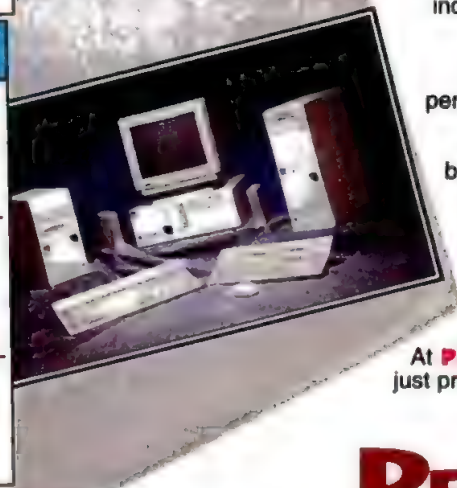
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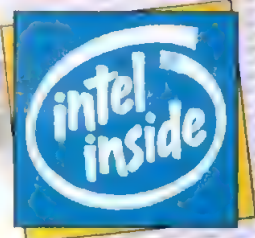


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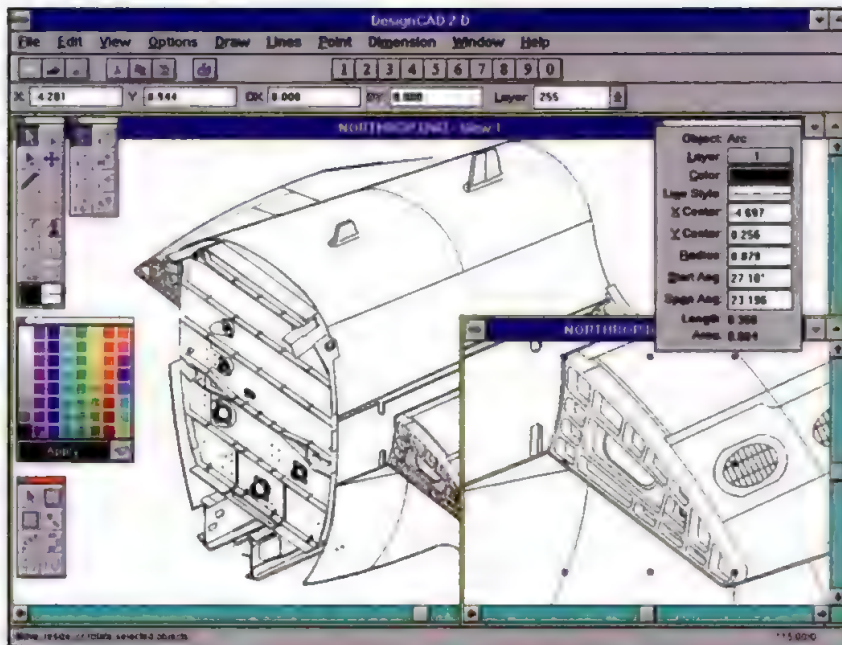
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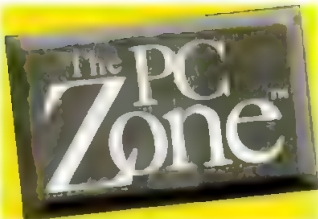
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13771	Netware 4.01-50 User	\$3,885.00

18336	PCI30 Arcnet Coax	\$68.00
14556	Ultra 16 Ethernet Coax	\$105.00
14553	Ultra 16 Ethernet 10BT	\$105.00
14550	Ultra 16 Ethernet Combo	\$119.00
18329	EtherCard+ Elite MCA 10BT	\$189.00
18335	PC60FS Arcnet Card Coax	\$109.00
14561	3608 Ethernet 8 Port Con 10BT	\$329.00

18351	Xircom 14.4 Pocket Modem Coax	\$447.00
18352	Xircom 14.4 Pocket Modem 10BT	\$447.00
18349	Pocket Token Ring III	\$455.00

09823	Jumbo 250MB Internal	\$187.99
12034	Trakker 120MB Parallel PORT	\$109.99
12035	Trakker 250MB Parallel PORT	\$324.99
18373	Power Tape 2 4GB SCSI External	\$1,087.00
18374	POWERDAT 2GB SCSI Internal	\$1,164.00

18375	TAPE 250MB Internal	\$159.00
18380	TRANSPORTABLE 150	\$343.00

05689	ACS 300 Spkrs W/ Subwoofer	\$230.00
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12900	Sound Blaster 16 SCSI-2	\$177.00
12919	Sound Blaster 16 AWE32	\$291.00
12536	Discovery 16 INT	\$249.00
18311	Multimedia Office	\$649.00

18805	SoundWave 32+SCSI	\$199.00
18806	SoundWave 16/EZ	\$99.00
18807	SoundWave 32	\$164.00
18808	SoundDrive 16/SCSI	\$129.00
18809	Vidalia	\$355.00

01164	Digital Headphones MDR-CD30	\$23.99
13166	SRS-D2K Speakers & Subwoofer	\$149.00
01172	B100 Computer Speaker System	\$98.00

Turtle Beach

19441	Masterkey Sound I.C.	\$349.99
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19443	Masterkey Sound I.C.	\$349.99
19444	Masterkey Sound I.C.	\$349.99

19445	Masterkey Sound I.C.	\$349.99
19446	Masterkey Sound I.C.	\$349.99
19447	Masterkey Sound I.C.	\$349.99
19448	Masterkey Sound I.C.	\$349.99

97815	MultiSpin 300 Internal	\$431.99
97814	MultiSpin 300 External	\$464.99
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13414	Chinon CDS535 INT CD-ROM KIT	\$379.00
13401	Chinon CDS535 EXT CD-ROM KIT	\$485.00
17885	Legend Int CD-ROM	\$188.00

19258	PX-43CH Quad Speed	\$489.00
94948	4-Bay Tower CD-ROM	\$1,775.00

17882	Sony CDU-555 Int. SCSI CD-ROM	\$109.00
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95242	Calcomp Slate 12x12 w/ Cordless II Button Cursor	\$246.00
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11931	ScanMaker II w/Photoshop LE	\$489.00
13175	ScanMaker IIS w/Photoshop LE	\$748.00
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11825	Creative Labs VIDEO SPiGOT	\$369.00
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06909	Multiscan - 17SE 17" Monitor	\$999.00
01157	Multiscan 2004e Monitor	\$1,099.00

15379	Graphics Wonder (ISA)	\$119.00
15380	Graphics Wonder (VLB)	\$119.00
12620	GRAPHICS ULTRA - 2MB	\$295.00
11891	GRAPHICS ULTRA PRO 2MB	\$275.00
13300	GRAPHICS ULTRA PRO 2MB EISA	\$305.00
14574	GRAPHICS ULTRA PRO 2MB VLB	\$275.00

19717	NEC XE 15 15"	\$549.00
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19719	NEC XE 21 21"	\$1,999.00
19720	NEC XP 15 15"	\$679.00
19721	NEC XP 17 17"	\$1,279.00
19722	NEC XP 21 21"	\$2,499.00

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18810	Kelvin EZ/VLB 1MB Dram	\$124.00
18811	Kelvin 64/VLB 1MB Dram	\$145.00
18812	Kelvin 64/VLB 2MB Dram	\$199.00
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18542	Force 14 486/33 4MB	\$1,999.00
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13680	TM4000M SX/25 120MB	\$2,649.00

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17623	TM4000M DXA/75 340MB	\$4,945.00
13672	TM4000E DXA/75 455MB	\$3,949.00

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19137	T3600CT 486DX2/50 250HD 4MB	\$3,995.00
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19704	Ready P80M Pentium/60 420HD 8MB	\$2,149.00
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17617	LabelWriter XL PLUS DOS/WIN	\$228.00
18993	BJC-4000 Color	\$409.00

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13188	LQ-5704	\$259.45

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13681	DeskJet Portable 310	\$299.00
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15358	National Semi NE4100 ENET Coax	\$189.00
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18403	Maxtor MOBILMAX 105MB HD	\$449.00
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How PC Direct Helped Computer Discount Warehouse Found "Customer Univ

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University — which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a \$10 million product inventory makes it possible for the company to provide same-day order shipment.

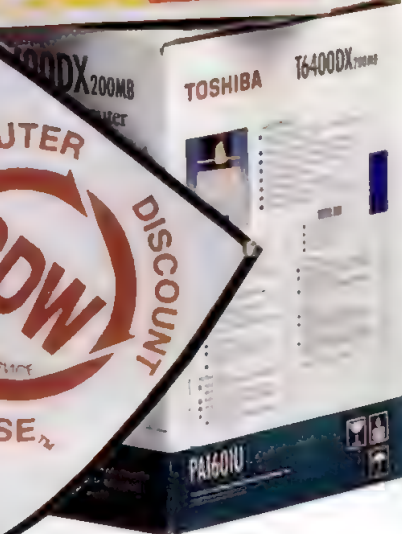
Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

If you're a direct marketer and you're looking for one million prospects who understand value and service, look no further than PC Direct. There's no better way to attract so many loyal, repeat customers.



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Arlington Computer Took a Long Term Business Perspective but Used PC Magazine for Immediate Results.

When Arly Guenther started Arlington Computer, he decided to take a long term approach by taking care of his customers so they would come back and become repeat buyers. According to Arly, this long term approach pervades everything they do—customer service, technical support, and advertising.

"When we started the company in early 1984," says Arly, "we believed that our success as a direct marketer would be tied to customer satisfaction. So we attempted to go into the direct advertising arena. Our strategy was to sell branded products at competitive prices while continually responding to the changing needs of our customer base. Two or three years ago, people might wait two or three weeks for a product. Now they want it overnight, and they want much more sophisticated technical support. After ten years of being in business, we really feel that our support is among the best in the industry."

When Arly chose the direct marketing channel, he knew the best way to maximize the return on his investment was to target business buyers that have enterprise-wide buying responsibility and buy many products in volume. He selected PC Magazine back in 1986 because its readers have the knowledge and responsibility to buy products for themselves and their organizations. In fact, because of the large volume buying, "PC Magazine has become Arlington's flagship publication, because its buyers buy many different types of products resulting in high average order sizes. All of this brings more revenue to the bottom line, and has allowed Arlington to grow to its present size."

"If you're in direct marketing for the long term, PC Magazine is an excellent choice. We run ads in PC Magazine consistently and have not missed an issue since day one." As a result, "last year alone our sales from PC Magazine were up over 30%." So, if you want your advertising message to reach the broadest, most sophisticated customer base, PC Magazine is definitely the place to be.

If you're a direct marketer with a breakthrough idea, bring it to the attention of 1,000,000 of the most active and knowledgeable PC buyers. Call your PC Magazine sales representative or (212) 503-5100 and get the facts about PC Direct.



Arly Guenther
President, Arlington Computer

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6. Vanity Fair	14. Spy
7. National Geographic	15. Consumer Digest
8. Crafts 'N Things	16. PC Magazine

**Four Ziff-Davis titles
are among the fastest-growing
magazines in single copy sales.¹**

That includes *all* paid magazine categories, not just computer publications.

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a host of competitors.

And earn readership from buyers required to pay full cover price. That's why it's especially important for advertisers to know that Ziff-Davis paid magazines set a torrid pace of 24.1%² growth in single-copy sales over the past 12 months.

**102%
circulation
growth in
just four years.³**

Our newsstand dominance is the result of record-setting performance. But it's only part of the story. Over the



¹ Ziff-Davis Single Copy Research Study, single copy sales as reported in Fax-Fax for the six-month period ending 12/93 and 12/88. BPA/ABC for the period ending 12/88. Includes titles selling more than 30,000 copies per issue since 12/88. ² Data as reported in the six-month periods ending 12/93 over 12/88. ³ 12/93 ABC Publisher Statements for PC Magazine, Computer Shopper, PC Computing, MacUser, Windows Sources. Average sales per issue, per year. 3. ABC/BPA Publisher Statements of average circulation, single copy sales, for the period 12/93 over 12/89 for PC Magazine, Computer Shopper, MacUser, PC Computing, PC Sources and Windows Sources.

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Circulation of five Ziff-Davis computer magazines is greater than that of the business magazines combined.

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last four years, Ziff-Davis total circulation has nearly doubled, today accounting for nearly 50% of all paid computer magazine circulation.

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Clearly buyers recognize that Ziff-Davis magazines deliver the most reliable product information.

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Ziff-Davis magazines are setting records for circulation growth and total circulation.

editorial and lab-based testing pays off for computer product buyers. And the advertisers who reach them through our magazines.

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Leave it to the computer industry to change the landscape. Reliable information about products is so critical to business buyers that the circulation of Ziff-Davis paid magazines now exceeds the combined circulation of BusinessWeek, Forbes and Fortune.

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Ziff-Davis magazines have set the standards for top editorial, scientific lab testing, record-setting newsstand performance and dynamic circulation growth. Advertising in Ziff-Davis magazines is simply the best way to reach more buyers at the most attractive rates. To set a few records of your own, get into the winners... the great magazines of Ziff-Davis.

ZD The Ziff-Davis Magazine Networks

4. Based on 1993 Publisher Statements: single copy sales per issue for the Ziff-Davis line and four leading competitors (PC World, Windows Magazine). All trademarks and registered trademarks are the properties of their respective owners. ABC/BPA Publisher Statements for Ziff-Davis line and BusinessWeek, Forbes and Fortune for the six months ending 12/93. © 1994 Ziff-Davis Publishing Company. All rights reserved.



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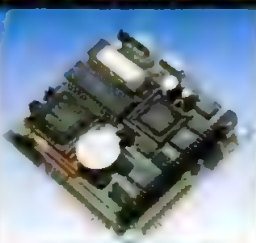
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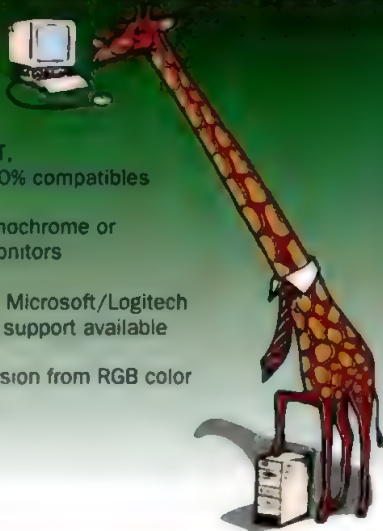
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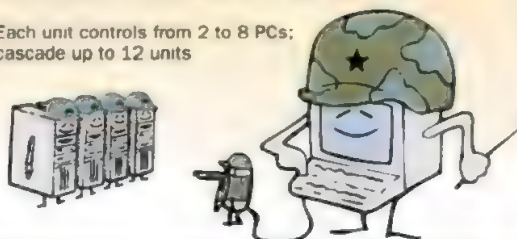
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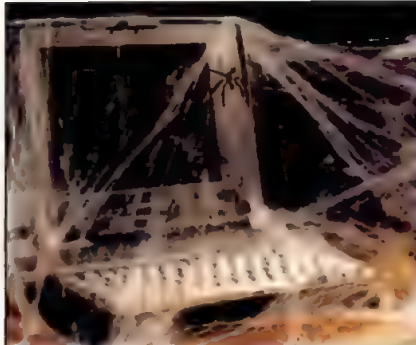


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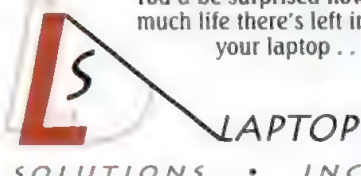
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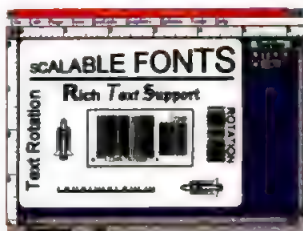
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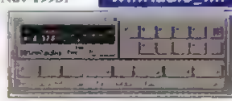
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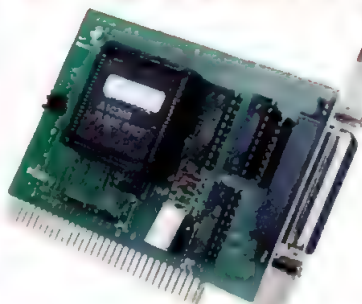
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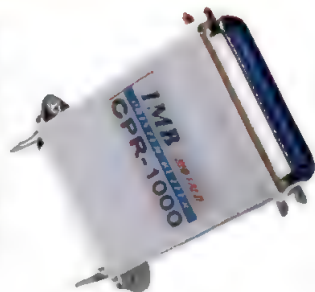
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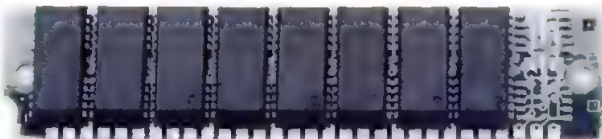
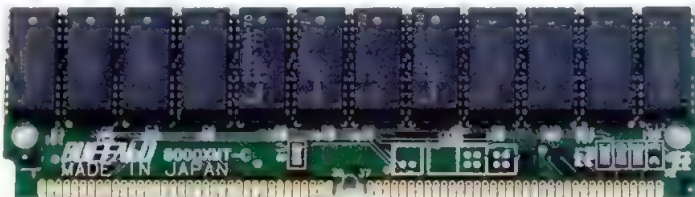
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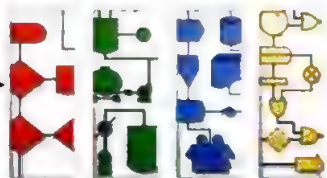
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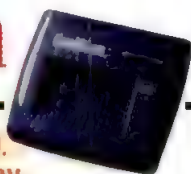
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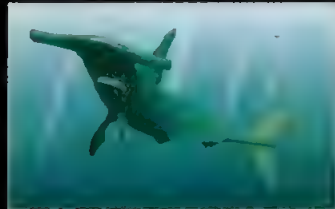
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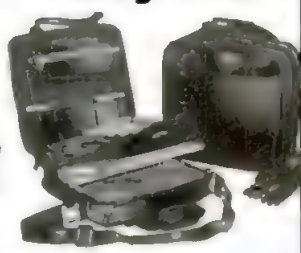
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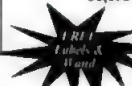
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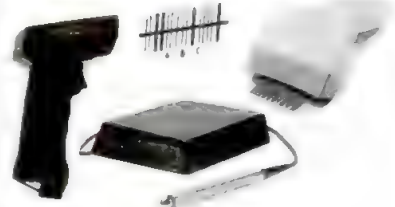
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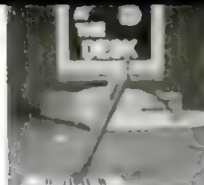
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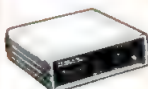
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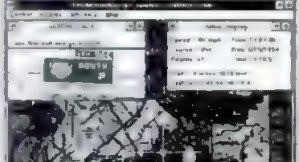
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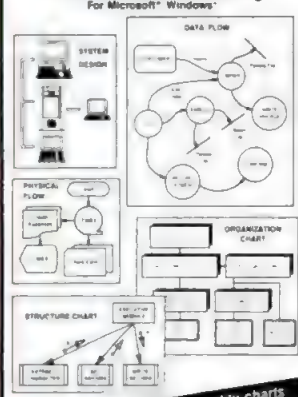
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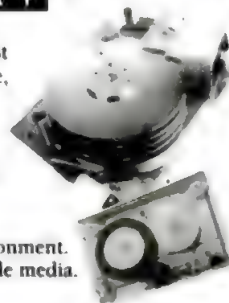


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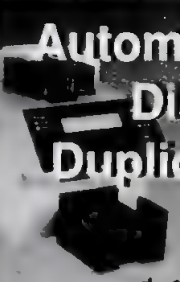
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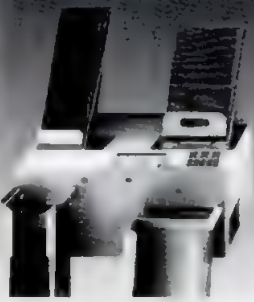
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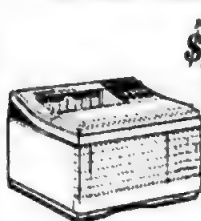
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07. ☐ Communications
08. ☐ Finance/Banking/Insurance/Real Estate/Accounting
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11. ☐ Research and Development
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13. ☐ Health/Medical/Legal Service
14. ☐ Engineering/Architecture

16. ☐ Agr./Const./Mining/Oil/Transp./Utilities
17. ☐ Non-Computer Retailer/Dist.
18. ☐ Other Business or Service

3. Please indicate your primary business function. (Check one)

01. ☐ DP/MIS
02. ☐ Systems, Programming
03. ☐ Communications
04. ☐ Engineering
05. ☐ Res./Dev./Scientific
06. ☐ Accounting/Finance
07. ☐ Computer Consulting
08. ☐ Purchasing
09. ☐ Operations
10. ☐ Production
11. ☐ Education/Training
12. ☐ Marketing/Sales
13. ☐ Medical/Legal
14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products?

01. ☐ 10 or less 03. ☐ 25-99
02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

01. ☐ Limited to mainframe
02. ☐ Limited to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location. (Check all that apply.)

01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC products?

01. ☐ Now 03. ☐ In 7 to 12 months
02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company.

01. ☐ 25 or less 03. ☐ 100-499 05. ☐ 1000
02. ☐ 26-99 04. ☐ 500-999

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PC 12/6-5

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1994 HOLIDAY GIFT GUIDE

A Gift for Giving



"Twas just days till the holidays and all through the house, ♪ The computers were silent—no one clicked a mouse. ♪ Pondering the gifts you had yet to buy, ♪ All you could think of were their plaintive cries: ♪ "I want games, I want gadgets, I want something new. ♪ I want tools, I want stories, and I want them from you!" ♪ So into the mall you trudged with a sigh, ♪ And spotted the software stacked up 8 feet high. ♪ With so many

titles and so many choices, ♪ Who could tell the Edsels from the Rolls Royces? ♪ And then in a flash, it all became clear— ♪ The only Gift Guide you needed was here! ♪ We've tried hard to bring you the best of the year, ♪ So you'd know what to buy for all you hold dear. ♪ Now as the After Hours elves fade out of sight, ♪ Happy holidays to all, and to all a good night!

—With apologies to Clement Clarke Moore

By Gayle C. Ebreman

Do you believe that the best gifts are the ones your family comes back to, again and again? If you do, this holiday season, think PC. Software and gadgets may not be as warm and fuzzy as a pair of animal slippers, but they'll be appreciated far more.

Our Holiday Gift Guide looks at the best offerings of 1994 in eight categories: Kids Software, Desktop Toys, Gadgets, Strategy games, Action and Adventure games, Simulations, and Home Productivity and Reference Software. Whether that special someone likes to solve puzzles, play piano, read stories, watch old movies, or destroy alien life-forms, there's bound to be something here that they'd be thrilled to find tucked next to the PC.



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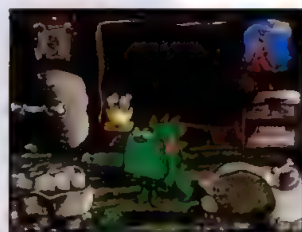
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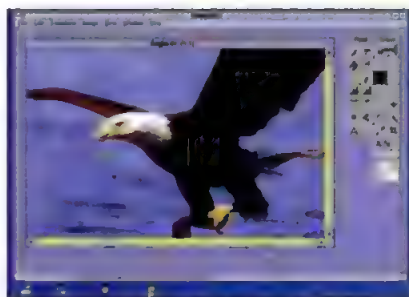
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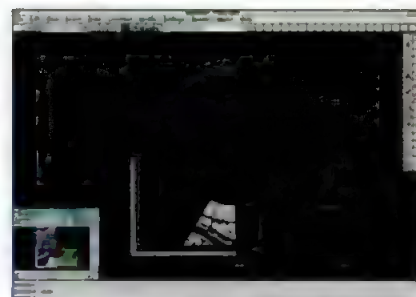
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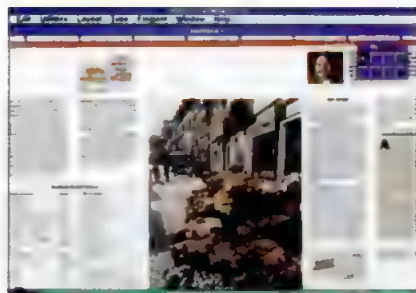
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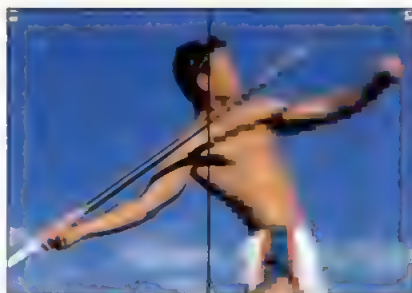
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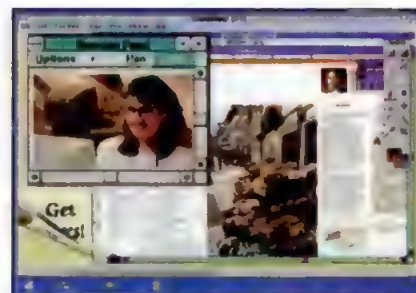
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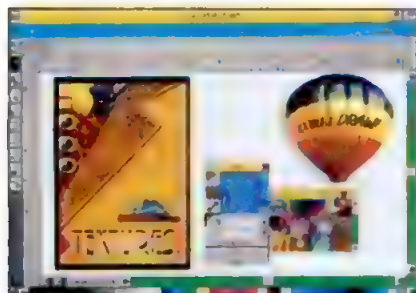
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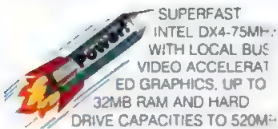
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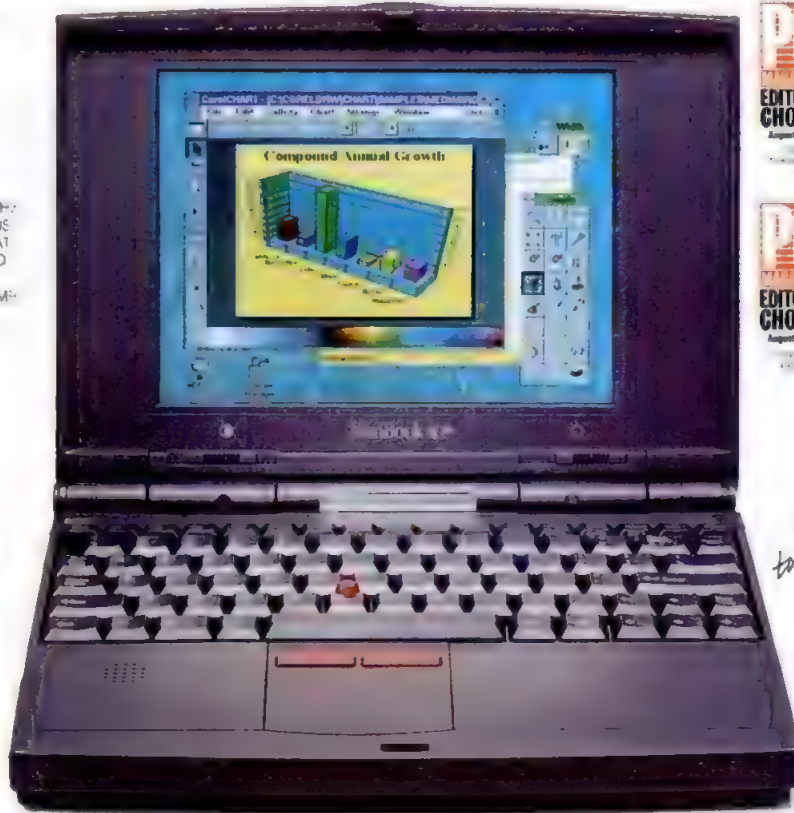
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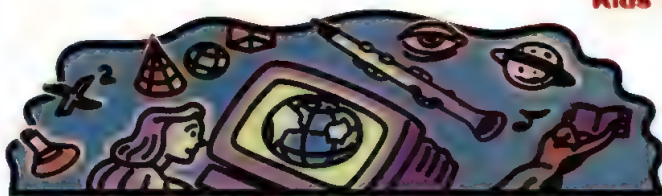
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Kids' Software



Kids Ages 3 to 6

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A child's work is play. And the best software for kids takes that play seriously, using colorful screens and animated characters to encourage curiosity, creativity, and learning.

Forget that purple dinosaur: **Reader Rabbit 1 Deluxe** (estimated street price, \$50; The Learning Company, 800-852-2255) throws open the doors to letter recognition better than any reptile ever could.

In this CD-ROM adventure, Reader Rabbit is joined at the Word Factory by Matilda the mouse, who helps kids play four word games: Matchup, Sorter, Labeler, and Word Train. Parents can set levels for each game, starting with pictures and

working up to simple words and letter combinations.

While the program's main focus is teaching phonics to beginning readers, it also bolsters visual discrimination and memory skills. After playing with the 200 consonant - vowel - consonant words in the program, kids will start to recognize simple words in their own bedtime storybooks.

Much more ambitious in scope is **Reader Rabbit's Interactive Reading Journey** (esti-

mated street price, \$99; The Learning Company, 800-852-2255). The 40 stories within this CD-ROM series begin simply,



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with only a few words to a page. As the child moves forward, the stories become more complex. In addition to the stories, there are more than 100 reading-related exercises and games that help build the child's store of "sight words," an essential component to good reading.

Reading and math programs make up a huge share of preschool software, so a science program is a welcome change. The floppy-disk-based **Sammy's Science House** (floppy disk or

CD-ROM, \$49.95; Edmark Corp., 800-691-2985) opens the door to science for your kids.

For young children, learning science means building such elementary skills as sorting and categorizing, deductive reasoning, and observation. Budding Mr. and Ms. Wizards practice the ideas behind scientific classification in the Sorting Room by separating such things as "animals without tails" and

"animals with fins," follow simple blueprints to build different objects in The Workshop, or try out their logic skills in the Make-a-Movie game.

Skills of an entirely different sort are the focus of Windows keyboarding tutor **Mavis Beacon Teaches Typing! For Kids** (\$49.95; The Software Toolworks, 800-234-3088). Mavis leads the way with basic typing lessons that start with single letters and progress to simple sentences. Kids can play the games

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Kids Software

in a discovery mode, which doesn't use the clock, or in a learning mode, which keeps records on as many as 20 players. Parents can set up individual lessons or let the program determine when their child is ready to advance.

If it's exploration and discovery you want for your kids, get out of the ex-burbs with **The Farm** (\$34.95; Humongous Entertainment, 206-485-1212). This CD-ROM captures, in words and pictures, all of the things that kids can learn from a trip to the country. Simple mouse clicks let kids explore everything from the vegetable patch to the mill.

Clever enhancements add zest and charm. For example, after clicking on the What Is button at the bottom of the screen, kids will see the corresponding word for each item they pass over with their question-mark pointer. It's easy to get a short definition of any object, and kids can also enjoy themselves with several simple games, such as a scavenger hunt, or with activities that use the included idea booklet.

A farm is just one part of a larger community that kids can explore in **How Things Work in Busytown** (\$49.95; Paramount Interactive, 415-813-8040), which is adapted from the work of Richard Scarry.

In this wonderfully simple



From single letters to simple words, Mavis Beacon teaches kids the right way to type.



Reader Rabbit's Interactive Reading Journey takes your children on the road to reading.

and engaging program, kids learn how communities are interdependent entities. For example, a child may enter the bakery to see how bread is made. But before the bread can be made, the baker needs wheat from the mill. At the mill, kids learn that the wheat must be grown on a farm. After moving to the farm, kids must help plow the field, plant the seeds, and water the plants.

That's the chief aim of preschool software: to teach young children how the world works. Their feeling of accomplishment, combined with the lessons they learn, makes their electronic playtime as valuable as the time they spend with blocks, dolls, and other toys.—*Peter Scisco*

The chief aim of preschool software is to teach young children how the world works.

Kids Ages 6 to 10

Eight Ways to Build Skills And Encourage Creativity



Crayola Art Studio and its sibling for younger kids **Crayola Amazing Art**

Adventure (estimated street price, CD-ROM or floppy disk, \$40; Micrografx, 800-676-3110) blend the best of traditional art activities with top-notch software design.

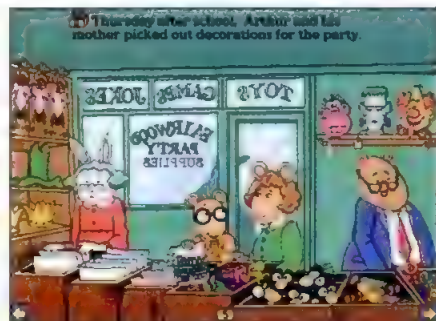
Both Art Studio and Amazing Art Adventure distinguish themselves with a simple interface that uses sound and animation to keep kids amused while exploring. Both packages feature activities that revolve around the creative use of color and animation. There are mixed-up pictures, pages to color, and a series of make-it-yourself activities. If they like, kids can start with a blank screen and create their own artwork using stamps, animated characters, text, and effects.

Creativity plays a different role in **Around the World in 80 Days** (estimated street price, \$44.95; EA*Kids, a division of Electronic Arts, 800-245-4525), which has adapted the classic tale in a way that gives children control over elements of the story by using tools called Paintbox Pals.

The story itself concerns a race around the world between Phineas Phogg and his nemesis

Hogsbreath. Depending on the situation that Phineas finds himself in, kids use one of the Pals to help. For example, if Phineas finds that his airplane isn't working, kids can use Nick Lead, the pencil, to draw a propeller and send him on his way. As kids direct Phineas from one locale to another, they can hear some brief facts about the country and have terms defined to strengthen their vocabulary.

Another vocabulary builder, and much more than that, is the electronic version of **Merriam-Webster's Dictionary for Kids**



Arthur's Birthday is a lively and funny adventure based on a Marc Brown story.

(\$49.95; MindScape, 415-883-3000). The familiar design of the bound dictionary is well adapted to the computer screen on this CD-ROM. A pleasant



Fun and games combine with wild-eyed graphics in Lenny's Time Machine.

Kids' Software



Math Workshop puts a new spin on learning basic skills, such as fractions.

Lenny's MusicToons such a hit.

Kids can use the Time Machine to travel along with Lenny from the age of the dinosaurs to the future. Each epoch comes with games and activities to stimulate thinking.

While Lenny's Time Machine provides a measure of

cultural and historical information, Lenny's Circus is nothing but a big top of fun. Kids participate in such circus escapades as firing off the human cannonball, playing arcade games along the midway, creating funny faces in the makeup mirror, or leading the circus band.

For more serious endeavors, your kids can test their mathematical mettle in the **Math Workshop** (estimated street price, \$40; Broderbund Software, 800-521-6263). Computer-pal Polly Gon (take that, Barbie) explains how to play the games that build math skills. Spatial visualization, for exam-

ple, is necessary for replacing the jumbled lines in the sticker game. To sharpen their computation skills, kids can roll a few games with Gus, the world's only bowling gorilla.

If you missed last year's Living Books title, **Arthur's Teacher Trouble**, make it up to your kids with **Arthur's Birthday** (estimated street price, \$39.95; Living Books, 800-521-6263). This electronic storybook, adapted from a print book by children's author Marc Brown, captures all of the charm of the original,

while adding the ambient animations and interactivity that define the Living Books series.

The story is simple: Arthur's birthday is Saturday afternoon. But as he passes out the invitations to his classmates, he discovers that Muffy is also having a birthday party on the same day. Kids can have the computer read them the story in English or Spanish, or they can explore on their own, clicking anywhere on the screen to launch scads of comical animations. —*Peter Scisco*

Kids Ages 10 to 14

Encouraging Imagination And Exploration in Teens



For encouraging exploration and problem-solving skills in teens and preteens, few titles can match the Carmen Sandiego series.

Where in the World is Carmen Sandiego? CD-ROM Deluxe

Edition (\$59.95; Broderbund Software 800-521-6263) is a welcome addition to the gang.

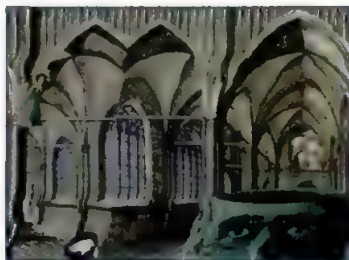
As in previous Carmen Sandiego games, players must race against time; if the clock runs out before the case is solved, the crook goes free. But if the player solves the mystery, he or she advances in

Liven Up Your PC with Animated Screen Savers

Boldly go where no PC has gone before with the **Star Trek: The Next Generation Interactive Technical Manual** (\$70; Simon & Schuster Interactive, 212-898-7671). A 360-degree representation of the Enterprise interiors lends a distinctly you-are-there touch to this self-guided tour, which lets you wander the corridors of the starship Enterprise. At another end of the science-fiction universe is **Star Wars Screen Entertainment** (\$35.95; LucasArts Entertainment Co., 415-721-3300), a background primer for the characters, events, and vehicles found in George Lucas's classic film.

Cartoon lovers will appreciate the detail and nuance of **The Far**

Side Screen Saver Collection (\$39.95; Delrina Corp., 800-268-6082), which adds a new dimension to the warped humor of Gary Larson's strip. Younger animation lovers will want to check out **Disney's The Lion King Screen Scenes** (\$24.95; Disney Software, 818-543-



The naughty bits are included in **Monty Python's Complete Waste of Time**.

4380), which offers 50 crisp still-images for use as wallpaper or screen savers. For those who prefer livelier entertainment, there's **The Simpsons Screen Saver** (estimated street price, \$30; Berkeley Systems, 510-540-5535), which lets you play a trivia game or try



Take a drawing lesson in **The Simpsons Screen Saver**.

your hand at drawing the characters freehand. Finally, for something completely different there's **Monty Python's Complete Waste of Time** (\$49.99; 7th Level, 214-

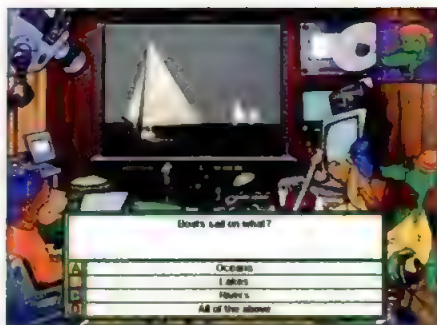
437-4858), an entirely interactive and entirely odd CD-ROM thingie. This disk includes video footage of the British comedy troupe and scads of games and activities, as well as The Desktop Pythonizer: a screen-saver, wallpaper, and sound-control utility that adds Pythonesque (read: rude and lewd) effects to your desktop.

—*Melissa J. Perenson*

DESKTOP TOYS



Kids' Software



Morgan's Trivia Machine is a hilarious quiz game that's perfect for the whole family.

rank. This episode has young detectives chasing Carmen's gang around the globe in search of clues that will help them recover stolen world treasures. What's new here are 900 additional clues, more animated characters, and 15 more countries for young ACME detectives to search, as well as foreign languages, fantastic photography from *The National Geographic*, and folk music

from the Smithsonian archives.

If your kids think chasing Carmen is fun, then they'll love chasing after a fortune in gold in **The Yukon Trail** (CD-ROM, \$69.95; floppy disk, \$59.95; MECC, 800-685-6322 ext. 529). This game takes off where the compa-

ny's popular, educationally excellent *The Oregon Trail* leaves off. This time, kids must make the journey from Seattle into the Yukon gold fields of Alaska.

To get started, electronic stampedes (as the gold-rushers were called) choose a suitable computer partner, outfit their party with supplies, book passage on a ship, make their way across a harsh wilderness,

and then try to strike it rich mining for gold. The whole process gets charted in a journal. The program makes some of the entries; kids can edit the journal and add their own entries. The game is full of unforeseen events calling for quick decisions. Only the hardest, smartest, and best-prepared pioneers will survive.

As an alternative, kids can trade the frozen tundra for an adventure inside a modern museum. **Museum Madness** (\$49.95; MECC, 800-685-6322 ext. 529), asks the mind-

boggling question: What happens when the national museum's computers go haywire and the exhibits come to life?

To find out, kids must work

to solve the mystery and put things right. First, they'll have to find a way into the locked museum.

They will have to make a series of logical deductions to win this challenging and informative game. But as they solve



That red-hatted thief is on the loose again in *Where in the World Is Carmen Sandiego?*

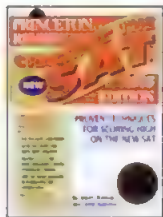
the puzzles, they'll learn about energy, transportation, space, ecology, history, and other subjects.

An adventure inside a

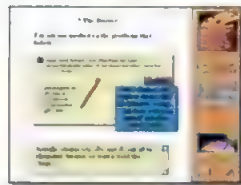
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Kids' Software

mixed-up museum is nothing like the hilarious romp through the human knowledge base called **Morgan's Trivia Machine** (\$34.95; Morgan Interactive, 800-245-4525). This question-and-answer-based learning game uses humor to appeal to kids, as well as their parents. At times, the narration is so funny it's as if Robin Williams had gotten loose in your system. More than 1,000 questions cover three categories: science, geography, and a potpourri of items called Grab Bag. You can set subjects and question difficulty for each player, which means that

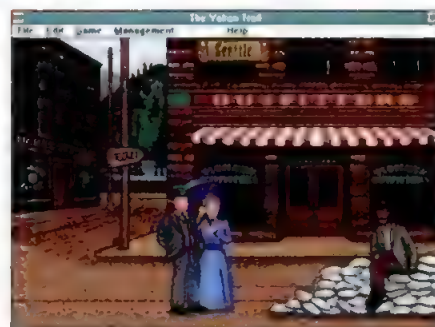
older and younger children can compete more evenly.

Kids who would rather create their own trivia game, or an MTV-style book report, will love **The Multimedia Workshop** (\$79.95; Davidson & Associates Inc., 800-545-7677). This program gives your budding producers all the tools they need to create a presentation laden with sound, video, and text.

The program covers every facet of the multimedia creative process, from writing and publishing to adding illustrations, photographs, and video clips. The heart of the program is the Se-

quencer, where kids lay out their scenes in a simple storyboard. Presentations can play automatically, or kids can control the action with the keyboard. Either way, book reports will never be the same again.

If your kids need a boost with their grammar lessons, try **Grammar Games** (\$49.95; Davidson & Associates, 800-545-7677). This drill-and-practice language tutor starts by giving kids a quick diagnostic test to set their skill levels for the four games. In Rain Forest Rescue, kids must distinguish complete sentences from sentence fragments. The Falling Fruit game drills proper punctuation. Hidden Wonders



Before leaving Seattle, you'd better get supplies and book passage for The Yukon Trail.

helps kids with verb/subject agreement, while Jungle Gizmos gives plenty of practice with plural and possessive nouns.

From adventure games to multimedia presentations, middle-school kids have nearly limitless choices when it comes to computer software. It's just the right match for their limitless imagination and energy.—Peter Scisco

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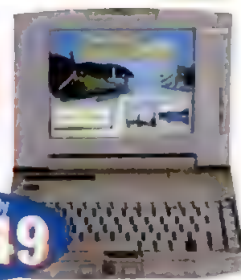
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- MS DOS 6.22 w/Data Compression
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486DX2	33 MHz	360MB	8MB	Y	3	1 MB	655/47H	\$1349
486DX2	33 MHz	360MB	8MB	Y	3	1 MB	655/47H	\$1399
486DX2	33 MHz	360MB	8MB	Y	3	1 MB	655/47H	\$1449

IBM PC 486 Pentium	Hard Drive Avg. Access	Standard RAM	Slots Bays	Flex Part #	Flex Price*
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Pentium P60-60	360MB 270	8 MB	5x3	655/47H	\$2349

*Monitor not included. Some systems available with optional RAM Drive configurations.
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The *Ultimate* Gotta-Have-'Em Gadgets

By Gayle C. Ehrenman

Sometimes software just isn't enough. If your favorite PC junkie yearns for something a bit more tactile, you've come to the right place. These six gadgets (for lack of a better term) are guaranteed to make games, music, and everyday computing more fun—and funky—than ever before.



The Flintstones Computer Accessory Kit

Turn your bland, old PC into a modern Stone Age machine. This kit includes a mouse, keyboard, mouse pad, disk holder, and monitor frame. They look silly but work great—and they put the personal back into computing (\$129.95; BrainWorks, 800-990-9989).

Vivid 3-D

Check out this little black box. Using only two powered speakers and some fancy technology, this device gives you 3-D sound so real you'll duck for cover when digital bombs drop (\$79.95; NuReality, 800-501-8086).



ArtPad

Finally, an affordable solution for those who find that "painting" with a mouse works about as well as typing with your mittens on. With this little pressure-sensitive tablet and cordless pen, the harder you press the thicker your digital strokes. The ArtPad can't promise you'll paint like Van Gogh (\$199; Wacom Technology Corp., 800-922-8613).



Phoenix Flight and Weapons Control System

This two-handed joystick may look intimidating, but you don't have to be a rocket scientist to program the 46 buttons or figure out the throttle and rudder controls. Just plug in this baby, and you'll soon be flying high (\$149.95; Advanced Gravis Computer Technology, 604-431-6020).

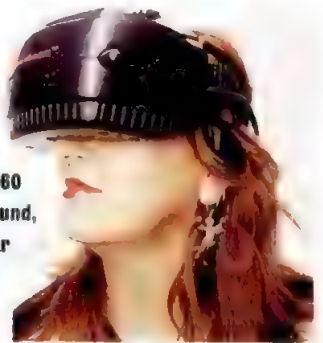


Gravis Personal Piano System

Here's everything you need to play piano and compose music. The system includes a wavetable audio board, a first-rate MIDI Keyboard, speakers, a MIDI adaptor, and Musicware Piano, an interactive piano-teaching program. (\$449; Advanced Gravis Computer Technology, 604-431-6020).

CyberMaxx VR Headset

Pop this cyber-helmet on your head, power up DOOM, and prepare for total-immersion gaming. With 360 degrees of virtual vision, stereo sound, and real-time tracking, you'll swear you can feel those demons breathing on your neck! (\$799; Victor-Maxx Technologies, 800-815-8299).



The Complete Multimedia Software Gift Guide

*Your personal guide
to buying software for
your home computer*



INSIDE:

*Sifting through
multimedia
software choices*

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AND DAZZLE, COMPUTERS
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AND FINDING A WELCOME
SPOT IN FAMILY ROOMS
ACROSS THE NATION.



Ten years ago, computers simply slapped numbers onto the screen, dutifully balancing checkbooks and analyzing mortgage rates—certainly not the most enchanting activities. ■■■ Today's computers are still balancing checkbooks and analyzing mortgage rates—in fact, they've gotten better at it than ever. But they've also learned to relax a little. They're playing back Charlie Parker licks, letting the kids create animated cartoons, and even showing video clips of Charlton Heston's chariot race in *Ben-Hur*. ■■■ The key is multimedia, a word that simply means being able to communicate in several different ways. Today's new multimedia PCs are mixing sound, photos and video along with their usual repertoire of text and numbers to create software that's more engaging than ever. ■■■ For example, the Microsoft Encarta™ multimedia encyclopedia not only lets you read about the moon, it lets you view a color photo of astronaut Buzz Aldrin, listen to Neil Armstrong's famous "One small step for man" speech, and watch an animation depicting the moon's orbit. ■■■ The extra energy's certainly catching on. Take a few minutes to discover the world of opportunities multimedia computing offers. In the next few pages, you'll find a variety of exciting new software titles built especially for multimedia enjoyment. They make great gifts for your friends, family — and you!

Multimedia Software: A World of Experience

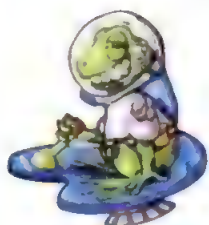


Ever see those old 1940s movies, where the whole household hovered around the radio, listening to evening shows? Even back then, technology helped bring people together. The radios eventually headed for a shelf in the garage, pushed aside by television technology. After all, it's only natural to want to watch the action, rather than merely listen to it.

Multimedia software can take you anywhere in the world, at any time — all from the comfort of your home computer. It's a sort of quick vacation — without travel agents and airports. Plus, with multimedia computers becoming popular in more and more households, multimedia software's becoming an excellent gift — a fun way to give a friend or family member exactly what they like.



Just For The Kids



Today, computers are as natural to kids as ice cream. They're using them in

schools, libraries, and at friends' houses. A lot of multimedia software is designed specifically for the younger generation, letting kids put their creative talents to work by writing stories, creating posters, or just having fun.



FINE ARTIST



Fine Artist has thousands of ways to turn your kids on to art. The program teaches basic art techniques, like adding dimension and shadows to increase realism. Yet it also comes with animated clip art and paint buckets to bring their creations to life.

McZee™ and Maggie, two characters in Fine Artist, help kids have fun while learning the program's basics; soon, they'll be creating animated pictures, buttons, stickers, posters, comic strips, and anything else they can think up.

The CD-ROM version, new this holiday season, is exploding with creative inspiration. With 600 pieces of clip-art, 300 sounds, and dozens of stunner backgrounds, your kids will be proud of what they can create.

Available on floppy disk and CD-ROM for Windows® and Macintosh®

"HOW THE LEOPARD GOT HIS SPOTS"

PJ. Rabbit takes children into the informative and imaginative world of Rudyard Kipling's captivating story, "How the Leopard Got His Spots." Narrated by Danny Glover, children at all reading levels can improve their reading skills by having the option of clicking on words to hear them pronounced and in some cases defined.



There are dozens of magical surprises waiting to be discovered. Children explore and find animals that suddenly come alive with the simple click of the mouse. Plus, there are four games included, like Mancala, the classic African stone game, offering hours and hours of additional fun. For children 4-9 years old.

Coming soon on CD-ROM for Windows.

SCHOLASTIC'S THE MAGIC SCHOOL BUS:

Explores the Human Body and Explores the Solar System



Starting this fall, kids will meet Scholastic's The Magic School Bus™ gang on PBS. And while their imaginations are fired up, they can enjoy hands-on Magic School Bus excitement with two new multimedia CD-ROM titles from Microsoft Home, inspired by the best-selling Scholastic books.

Join Ms. Frizzle and the class on a wacky trip into...Arnold's body. Along the way, you'll explore how the human body works as you discover a way out of Arnold and win the game! Or take an interplanetary adventure as you blast off into the solar system. Ms. Frizzle gets lost in space! It's your mission to collect clues, discover the secrets of the solar system, and find the Friz to win the game!

Available on CD-ROM for Windows.

CREATIVE WRITER



Unlock your kids' natural creativity! Creative Writer is a creative writing program that lets kids write and print stories, newsletters, banners, posters, and much more. If writer's block sets in, kids can head for the Splot Machine — a creativity booster with 8,000 ideas for new stories.

Special lettering effects add color, shapes, and shadows to words; spell checkers can cut back on mistakes — as can an Undo feature, which will undo mistakes as far back as 20 steps. Kids can illustrate stories and projects with clipart, or add sounds to their creations. The CD-ROM version, new this holiday season, adds Author Inspirations, even more creativity projects to jumpstart kids' imaginations! Available on floppy disk and CD-ROM for Windows and Macintosh.

EXPLORAPEDIA



Microsoft Explorapedia™, the children's interactive encyclopedia series, engages a child's sense of imagination and fun. The first in the series, "The World of Nature," and "The World of People," make learning and exploration fun and engaging. Kids can use it for schoolwork, or have fun browsing and exploring to help develop

op creative writing and thinking skills, as well as develop early reference skills.

On each disk, up to 200 topics are brought to life through a wide range of rich multimedia, including video, animation, and sound, so the fun of learning just keeps coming.

For early readers, there's the option of full text narration. And for older kids, there's the ability to explore topics in greater depth with "find" and "see also" reference features.

Coming soon on CD-ROM for Windows.

GAHAN WILSON'S THE ULTIMATE HAUNTED HOUSE GAME



Gahan Wilson, the master of the macabre, has created this most unusual house. Inside, you're trapped and you must visit the 13 rooms of the house in your quest to find the 13 missing keys before time runs out.

Along the way, you'll meet a cast of characters, some who will help you, others who can trick you! Visit the animals in the menagerie, but heed the warning and don't feed the fish! Try cooking up a ghastly stew in the kitchen or play a most unusual organ in the music room.

Since the house is haunted, the game never plays the same way twice. For children ages 8 and up.

Available on CD-ROM for Windows and Macintosh.

Multimedia Software Everyone Will Enjoy!

Multimedia is a whole new world for your household to explore. Sure, you're still working with a computer. But the computer will slowly melt away into the background as the screen comes to life in new and enjoyable ways.



MICROSOFT ENCARTA



Award-winning Microsoft Encarta brings information alive. Find facts, enjoy browsing and exploring, or create exciting reports with Encarta.

Updated annually by Encarta's editorial staff, working with authorities in every field, Encarta '95 offers more than 26,000 fully updated articles.

The unique Pinpointer search tool finds the information you need quickly and easily. Narrow your search for any fact by defining criteria such as word, time, place, category, or media. InterActivities offer a fun new way to learn and explore.

More than 100 videos and animations bring historical footage and intriguing scientific demonstrations to your computer screen. An amazing nine hours of sound — everything from animal cries to symphonies.

Microsoft Encarta is a visual treasure trove with more than 8,000 photos, illustrations and tables, and 900 colorful maps. Available on CD-ROM for Windows and Macintosh.

MICROSOFT BOOKSHELF '94

Microsoft Bookshelf '94 includes new or updated versions of *The American Heritage Dictionary*, *The Original Roget's Thesaurus*, *The Columbia Dictionary of Quotations*, *The Concise Columbia Encyclopedia*, *Hammond Intermediate World Atlas*, *The People's Chronology*, and *The World Almanac* and *Book of Facts 1994*.

Bookshelf '94 CD-ROM reference library brings reference material to life — complete with more than 60 animation and video clips of historic events; more than 80,000 spoken pronunciations; 40 audio clips of John F. Kennedy, Dylan Thomas and others; and more than 160 national anthems. You'll also find 230 flags and more than 160 maps. And automatic links quickly take you to related topics throughout Bookshelf '94.

Available on CD-ROM for Windows.



MICROSOFT COMPLETE BASEBALL



For starters, Complete Baseball, an official publication of Major League baseball, gives you comprehensive statistics for every player who ever made it to the big leagues. But there's more. See and hear the greatest players of all time with 9,000 images and nearly 100 audio recordings and action clips. The trivia quiz poses over 900

questions that will put even the most savvy baseball buffs to the test. That's triple value — and here comes the home run. Complete Baseball also offers an on-line subscription service, *Baseball Daily*, that delivers the latest stats via your modem — updated every day throughout the season.*

Available on CD-ROM for Windows.

* Available in the United States and Canada for a nominal fee.

ANCIENT LANDS

Ever been curious as to why the Egyptians wrote in such a distinctive style? What was a typical Roman diet? Ancient Lands explains it all in vivid detail. It brings the ancient civilizations of Rome, Greece and Egypt to life by exploring customs, politics, lifestyles, history and legends.

Explore on your own through more than 1,000 articles, or take a guided tour — listening to a narrator explain the how's and why's of ancient ways.

Available on CD-ROM for Windows.



DANGEROUS CREATURES



The wolves are howling — but from the safety of your computer. Dangerous Creatures brings 250 of the wildest animals of the world into your home. One hundred videos, the sounds of the wild and hundreds of photographs answer questions about the most dangerous — and endangered — animals on earth.

Your purchase helps to support the conservation efforts of the World Wildlife Fund.

Available on CD-ROM for Windows and Macintosh.

CINEMANIA '95

Which movie to rent? Where was Jack Nicholson born? It's all here in an entertaining guide to movies and the people who make them. Our all-star cast includes Leonard Maltin, Roger Ebert, and Pauline Kael — nearly 20,000 movies covered in detail! You'll also find biographies of the stars (nearly 4,000 in all), a complete list of Academy Award® nominees and winners, hundreds of movie stills, music tracks, and dialog — even video clips for some of the all-time classics. Microsoft Cinemania® '95 interactive movie guide is a 5-star hit! Available for Windows and Macintosh.



ART GALLERY

Imagine packing your house with 2,000 masterpieces from great artists like Monet, Titian, Turner, Vermeer, Rembrandt, and others. It's possible with Art Gallery — a detailed collection of masterpieces from the national gallery in London, one of the world's finest collections. Take a guided tour to see the highlights or feel free to browse, reading fascinating facts behind hundreds of paintings. Ready to grab a brush? Then watch the animated segments showing the techniques of the greatest artists.

Available for Windows and Macintosh.



FLIGHT SIMULATOR

You're cleared for takeoff and ready for the wild blue yonder with Microsoft Flight Simulator™. Take control of a photo-realistic instrument panel. Cruise over the 3-dimensional satellite-based scenery and see lifelike colors and nighttime lights across the countryside. Test piloting ability by completing a Flight Challenge. With the Scenery Add-ons you can soar from the skyscrapers of New York and the lights of Paris to the tropical shores of the Caribbean and the beauty of Japan's Mount Fuji. Escape to a new world — at home!

Available for MS-DOS, Look for Version 4 for the Macintosh.



SPACE SIMULATOR



Space Simulator is your passport to the galaxy, showing you the multitude of stars, planets, comets and other celestial objects that compose our universe. Take your pick from a fleet of spacecraft, including the Lunar Lander, Space Shuttle, and a Manned Maneuvering Unit, or see the sights through the full featured Observatory. Stunning, photo-realistic graphics and accurate planetary movement and gravitational forces make interstellar journey come to life.

Available for MS-DOS.

MICROSOFT GOLF 2.0

Microsoft Golf 2.0 is the most realistic golf simulator for Windows. Play the famous Firestone County Club in rich photorealistic graphics, with its blowing winds and chirping birds, without reserving a tee time. For the real competitors at heart, record your games and send them to your friends to play against, or review how you're playing with Golf 2.0 up-to-the-hole statistics. Version 2.0 available on floppy disk for Windows. Version 1.0 available on CD-ROM for Windows.

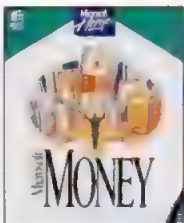


Make Your Life Easier



Today, computers and entertainment go hand-in-hand. But don't forget the original reason they entered your homes — to organize lives, increase productivity, and help you communicate better.

MICROSOFT MONEY



Nobody really likes organizing their finances — so Microsoft Money makes it a little easier. Use it to easily access your financial information, manage accounts, print checks, prepare tax information, track expenses against a budget, Bank-On-Line* and much more.

Built-in financial wizards help you with retirement planning,

comparing mortgages, evaluating loans, and choosing the right savings options. Charts and graphics help display your finances in an easy-to-read manner, while Cue Cards, AutoBudget and a host of other features get you on the road financial organization quickly. And now get a special offer on Reuters Money Network.

Available for Windows

*Bank-On-Line services are available for a monthly fee from participating banks.

MICROSOFT WORKS

Microsoft Works combines the most important productivity tools with common sense ease-of-use so you can get your computing tasks done quickly and easily.

Everything's there: A word processor for writing letters and reports, a spreadsheet for monitoring finances, a database for tracking household inventories, and more. And since all the programs work together, they can all share the same information and commands.

Available for MS-DOS, Macintosh and Windows.



MICROSOFT PUBLISHER

You don't need any design experience to get great-looking results with Microsoft Publisher — the world's best-selling desktop publishing application. That's because Microsoft Publisher simplifies every aspect of the design process, and makes it fun to get the results you want. Now get the power to create high-quality newsletters, brochures, flyers, banners, greeting cards, invitations, and more in a few easy steps. And for additional clipart, templates, and fonts try one of the Publisher Design Packs.

Available for Windows on floppy disk and special CD-ROM including the Special Occasions Design Pack and other extra values.

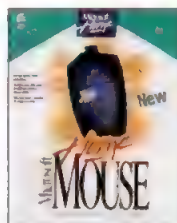


MICROSOFT HOME MOUSE

Get your hands on the new Microsoft Home Mouse. It's specially designed to fit any type of hand — large or small, left or right. Which means everybody will enjoy using it.

And the Microsoft Home Mouse comes with the Home Editions of IntelliPoint software that lets you personalize your computer with animation that accompanies mouse clicks. For example, point with a plane and see a toucan when you click!

Available for Windows.



MICROSOFT SCENES SCREEN SAVERS

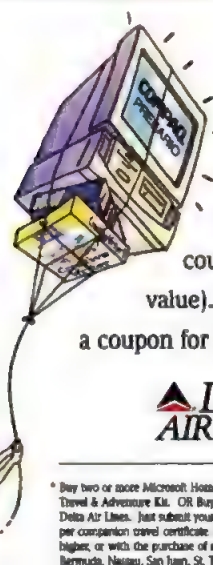
Save your monitor from burn-in and yourself from burnout with the Microsoft Scenes collection for Windows. Scenes bring new worlds to your PC. With seven Scenes Collections available, you can experience everything from the Stealth Bomber to 3-D stereograms to the most stunning spots in nature — right on your PC.

Scenes also brings you a new way to personalize your PC: with your own photos! That's right — you can turn your photos into a special screen-saver collection. It's a great way to keep images of favorite places and people nearby. Available for Windows.



Here's a good idea!

With the Microsoft Home "CD Sampler" you can preview over 55 different Microsoft Home software titles before you buy. It sells for around \$4.95, with it you get a \$10 rebate coupon good toward your next Microsoft Home software purchase. Stop by your local software retailer or call Microsoft at 800-228-6224, dept. GM6 for details.



FLY WITH US.

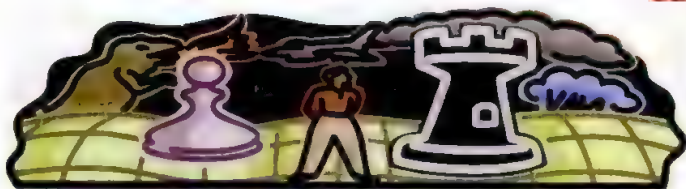


Buy two or more Microsoft® Home products and a Compaq Presario and qualify to receive a coupon for two free Delta Air Lines Companion Tickets, plus a free Travel & Adventure Kit (\$500 value). OR Buy two or more Microsoft Home products or a Compaq Presario and qualify to receive a coupon for a free Delta Air Lines Companion Ticket.*



* Buy two or more Microsoft Home products (or Microsoft Works or Microsoft Publisher) AND a Compaq Presario PC between October 15, 1994 and January 15, 1995 and qualify for two free companion travel certificates from Delta Air Lines and a Travel & Adventure Kit. OR Buy two or more Microsoft Home products (or Microsoft Works or Microsoft Publisher) or a Compaq Presario between October 15, 1994 and January 15, 1995 and qualify for a free Companion Travel certificate from Delta Air Lines. Just submit your original coupon (available at your participating retailer) and a copy of your sales receipt by February 15, 1995 to "Fly With Us", P.O. Box 3306, Peachtree City, GA 30269-7306. There will be a \$10.00 processing fee per companion travel certificate. Checks and money orders only, please. Allow two to three weeks for delivery. Certificates may be used only with the purchase of a round-trip ticket issued at any applicable published Domestic fare of \$350.00 or higher, or with the purchase of a round-trip ticket issued at any applicable published International full business (C class) or economy (Y class) fare. Domestic destinations include the 48 contiguous United States, Alaska, Hawaii, Canada, Mexico, Bermuda, Nassau, San Juan, St. Thomas, and St. Croix. All travel must originate in the United States on Delta Air Lines or Delta Connection Carriers. Tickets must be purchased by midnight, March 31, 1995 and all travel must commence on or after November 1, 1994 and be completed on or before June 1, 1995 for International travel, and on or before July 1, 1995 for Domestic travel. Travel is not permitted November 23, 1994 through November 29, 1994 and December 15, 1994 through January 3, 1995. This certificate may not be used retroactively for any previously issued ticket and is not combinable with any other air travel certificate. Limit 3 certificates per household or organization.

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Strategy Games

If You Build It and Manage It Well, They Will Come

This always the season to exercise your intellect and your hand/eye coordination, and there's never been a better time to give a gift of electronic fantasy and frustration. The latest crop of PC games talks back, serenades, wanders through 3-D spaces, and interacts with you via colorful graphics and digitized versions of live actors.

In **Heroes of Might and Magic** (\$69.95; New World Computing, 800-325-8898) you play one of four medieval lords ordered by four different kings to conquer a vast new world. Starting with one castle, you must explore the countryside, gathering precious resources, locating artifacts, conquering cities, and enlisting the help of several dozen monster races. The approach you take—who you attack first, what you build,



Amass the necessary resources and the New World is yours in Sid Meier's Colonization.

where you explore—is entirely up to you. Each game demands new strategies, because the world is completely regenerated with well-drawn new continents and terrain features.

The new world is also the setting for **Sid Meier's Colonization** (\$57.95; MicroProse Software, 410-771-0440). Here, that new world is America, but don't expect realism. Instead, look for an extremely reconfigurable, well-balanced strategy game, along the lines of game-

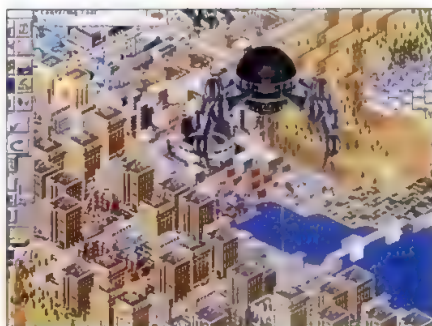
creator Sid Meier's earlier effort, *Civilization*.

In *Colonization*, your task is to colonize America, by amassing the resources, wealth, and

specialized colonists necessary to build secure cities. There's lots of variety here: You can play as the English, Dutch, French, or Spanish, roam 21 varieties of terrain, add 41 different types of buildings to your city, and then populate it with 25 types of specialized colonists. As if that weren't enough, you've got Indian tribes, privateers, extortionate taxation, and three international competitors to worry about. Unimaginative graphics

are the only letdown to this otherwise engrossing strategy release.

Constructing a more modern city lies at the heart of **SimCity 2000** (\$54.95; Maxis, 510-254-9700). Like the original *SimCity*, this simulation duplicates real-world conditions with remarkable accuracy; the graphics are far more detailed



SimCity 2000 updates the city-building metaphor with new views and problems to solve.

here, though, and you have more control over the design and management of your city. The goal remains the same: Build a profitable and well-populated city. Lay down the roads, water supply, and electricity lines, and then start erecting structures, including some new types, such as bus stations and subways. If you don't make your model city an attractive and safe place to live, the Sims will move to one of your surrounding sister cities and you'll be the mayor of a ghost town.

A ghost town, or more precisely planet, is just what you're faced with in **Alien Legacy** (\$49.95; Sierra On-Line, 800-757-7707). The plot is standard science-fiction fare: Aliens from Alpha Centauri have destroyed the Earth, and a pair of colonization ships have been launched

toward the distant Beta Caeli system. When you arrive at that location a quarter of a century later, you find not thriving colonies, but a barren wilderness.

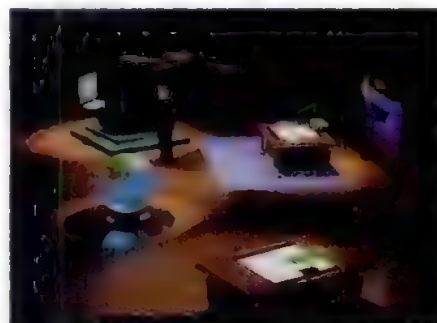
Your mission is to create new colonies, assembling factories, power stations, and habitats along the way. Of course, you'll also have to contend with

a series of plot crises, such as a very angry race of powerfully telepathic natives. And you'll have to deal with conflicting recommendations from a series of meddling advisors.

Last year's *Shadow President* used the 1990 CIA World Factbook to store 200-plus variables in

each of 150-plus nations around the world. The result was an unprecedented simulation of global relations—but as a game it was dull, and visually it was nowhere. Now we have **CyberJudas** (\$79.95; Merit Studios, 214-385-2353), a strategy-based sequel to *Shadow President* that combines that game's informational content with entertaining play.

In this CD-ROM-based game, you again play the President, pitted against a ring of high-placed traitors that have infiltrated your cabinet. As you pursue your



In CyberJudas, you are the President and there are traitors in your cabinet.

..... Your daughter created a playbook for the high school

And



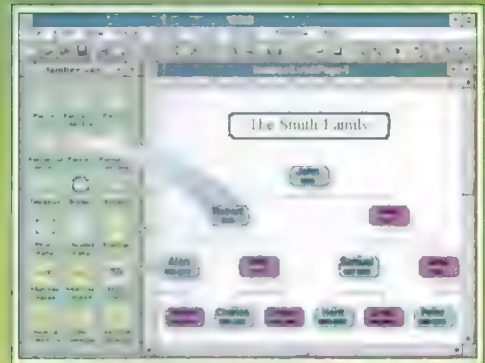
Even if you don't have an artistic bone in your body, you'll be drawing all kinds of neat stuff in no time. The kind of stuff you would only be able to create by spending a small fortune on several different drawing programs. And get this, with Visio Home you *won't actually be drawing a thing.*

Introducing Visio® Home. It's the essential, all-in-one drawing tool for your home PC. With it you can create just about anything you can think of. Even the stuff your dog might dream up. How is this possible, you ask? Visio Home is jam-packed with 30 stencils and over 900 pre-drawn SmartShapes®. All you have to do is drag and drop shapes from stencil to page and you're done. It's fun. It's easy. [And isn't life a little better when things are fun and easy?] Normally you'd need stacks of drawing programs to do everything Visio Home does. But for just a few bucks and a few minutes of your time, you'll be creating maps, science projects, floor plans, calendars—you name it. So there really is something for everyone in the family. If you're not



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**family tree. Your son drew a
football team.
the dog added
a sleeping loft to
his place. *Okay, you helped the dog.***



So you can't draw your way out of a paper bag. No problem. Using Visio Home is cake. Choose a shape from the stencil. Drag it and drop it on your drawing page. Type to add text. And you're done. In technical terms: Drag. Drop. Done. And if you ever need any help just click on the right mouse button. Pretty nifty stuff, huh?



completely, totally, unequivocally satisfied, there's a 60-day money-back guarantee. You and Visio Home. The possibilities are endless.

Here's the deal. Normally, Visio Home sells for \$79*. Now it's only \$49! To order or get the name of the nearest reseller, call (800) 457-3335, ext. B29. Do it now.



Household drawing for everyone in the house.™

*Suggested retail price.

Games

own international strategies, those who wish to bring down your government seek to destabilize global hot spots.

Visually, *CyberJudas* is outstanding. Its 3-D, high-tech setting and vast, shad-

owed spaces convey a sense of power and isolation. There's enough entertainment value here to run with the pack and enough informational value to teach a university-level course in global politics.

—Barry Brenesal

Action and Adventure

Solve, Shoot, and Puzzle Your Way to Holiday Gaming Happiness



While most undemanding of your system, **DOOM II: Hell on Earth** (\$69.95; GT Interactive Software, 800-362-9400) certainly puts the the pressure on your shoot-'em-up skills.

Those loveable monsters from the original shareware DOOM have made their way to Earth (turning many of your fellow earthlings into flesh-eating zombies); it's up to you to get rid of them, even if it means a trip to Hell. Of course, it wouldn't be a sequel to DOOM if you didn't get to roam through endless mazes of corridors while using an arsenal of weapons to mow down everything in your path.

The graphics and speed have been enhanced in this version; but just as in the original, if you get lonely on your crusade, you can dial up or network with a friend to clean up the planet in tandem.

For DOOM-like carnage with a cutting-edge sense of

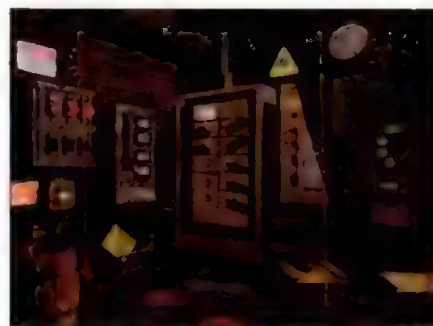
humor, try **The Fortress of Dr. Radiaki** (floppy disk or CD-ROM, \$59.95; Merit Studios, 214-385-2353). In this 3-D-maze adventure, you'll mow down everything from killer robots that spew toast out of their heads, to mutant samurai that commit hara-kiri before you can kill them. The graphics are first rate and the play fast and funny.

If you get your kicks from preventing rather than instigating mass destruction, plug into **Blown Away** (estimated street price, \$55; IVI Publishing, 800-432-1332), a tie-in to the movie. Here you play bomb-expert Jimmy Dove, who's desperately trying to rescue loved ones trapped in the explosive clutches of bomb-master Gaerity's protégé

Justus. The rescues pit you against the detonator clock to solve puzzles, find clues, and navigate mazes while Justus beleaguers you through the wonders of modern video technology. Digitized actors, beautifully rendered 3-D graphics,

and, of course, the occasional explosion add realism to the chase.

For a less hands-on approach to murder and mayhem, test your prowess in the



Solve the puzzles and you'll save your loved ones from an explosive ending in *Blown Away*.

cockpit of **TIE Fighter** (estimated street price, \$63.95; LucasArts Entertainment Co., 800-782-7827). In this DOS-based sequel to *X-Wing*, you're a Starfighter Pilot in the Imperial Forces, hurling your



Matching up bricks with same-colored neighbors is the simple premise behind *BreakThru*.

way through a 3-D universe while blowing the Rebel forces out of the sky with concussion missiles, proton torpedoes, and other nifty warheads. The action is based on *The Empire Strikes Back*, but this time, you're playing on the Dark Side's team.

What elevates *TIE Fighter* above most shoot-'em-up games are the adventure-game activities, such as mission assignments and debriefings, as well as the movie-style transi-

tion sequences that are intended to provide you with motivation for your actions. The graphics are typical Super VGA but hold up better than average during fast travel through stars; a joystick and 2MB of free expanded memory come highly recommended.

An arcade game with an even juicier plot, **JumpRaven** (\$69.95; CyberFlix, 615-546-1157) offers up politically correct cyberpunk with a punch line. Skin-

heads have made off with the last genetic samples of extinct wildlife; your job is to chase them down and recover the samples. The graphics are great and the action is fast, but what really sets *JumpRaven* apart is the edgy, satirical humor that pops up in the copilot interviews and in the ever-present advertisements ("Neutralize that acid rain with Lime Away!"). Best of all, you get to personalize your mission by choosing a copilot and a soundtrack. Go for the Seattle grunge as your background music; you won't be sorry.

The less bloodthirsty might want to tear down walls instead. Relying on a quick wit as well as quick reflexes, **BreakThru** (estimated street price, \$45; Spectrum HoloByte, 800-695-4263) takes you on a destructive tour of famous walls from history. In this Tetris-like game, your goal is to match colored blocks to remove them from the wall. You have bombs and rockets to help you and obstructive spi-

DOOM II
is undemanding
of your system
resources, but will
put the pressure
on your shoot-
'em-up skills.

Games

Required Reading for Gamers

Sometimes you need more than just on-line help to get you flying, fighting, or solving. Here are a few good reads that are also good helpers.

Whether you're a flying ace or just trying out your wings in Microsoft Flight Simulator, you'll find both *Adventures in Flight Simulator* by Timothy Trimble (\$22.95, Microsoft Press) and *Taking Flight* by Christopher D. Watkins and Stephan R. Marenka (\$29.95, M&T Books) excellent flight attendants.

Adventures takes you through the basics—from preflight to takeoff, maneuvering, and landing—in step-by-step instructions. Once you get the hang of flying, try one of the six guided adventures. More seasoned flyers who are ready to begin building their own sims will appreciate the flight-simulation source code included with *Taking Flight*. The book also recaps the history of flight simulation.

For those who belong to the



Turn to *Taking Flight*, the history of flight simulation.



Net Games explains where to find games on-line.

cult that surrounds DOOM, nothing will be more welcome than

Jonathan Mendoza's *The Official DOOM Survivor's Strategies & Secrets* (\$19.99, Sybex). This guide tells you everything you need to know to get you through the first three episodes of the original game with your sanity intact. There's also a section that briefly explains how to use the different on-line DOOM add-ons.

Know someone who's still mystified by the world of *Myst*? Tuck a copy of Rick Barba and Rusel DeMaria's *Myst: The Official Strategy Guide* (\$19.95, Prima Publishing) into her stocking. This sanity saver includes a complete walk-through of the game, as well as detailed examinations of the puzzles.

How about a game of chess with someone across the country? Just grab Michael Wolff's *Net Games* (\$19.00, Random House Electronic Publishing) and log on. The book is packed with information on where you can find any game that you may want to try out against on-line friends.

—Tin Albano



GAME BOOKS

385-2353). A plane carrying the Psychotron, a mind-control device that the U.S. bought from the Russians, has crashed; the device and a CIA operative charged with guarding it are missing. Your job is to track them down by interviewing digitized actors (more accurately overactors, as in many games which use this technology) and poking through 3-D-rendered locales with a cursor that politely indicates where clues are hidden. But it's all hush-hush; nobody at the CIA wants a scandal.

Psychotron immediately sucks you into the plot and the intriguing characters, but it also sucks up power. For optimal playback, this Windows-based game really demands a good double- or even triple-speed CD-ROM drive and a graphics adapter with a fast 15-bit or better color mode.

But if you really want to knock the socks off the adventure gamers on your gift list, the stunning 3-D graphics, sound, puzzles, and plotline of *Myst* (\$59.95; Broderbund Software, 800-521-6263) won't let you down. An almost classic adventure game, *Myst* takes you on a through-the-looking-glass trip into a library book, where you wander around a lovely, mysterious island, trying to unravel an age-old family tragedy.

Novice gamers may get lost when dropped into the *Myst* environment, since the interface is pretty Spartan. But the story is so engaging, and the environment so rich, that they'll quickly overcome their inhibitions and become lost in the intrigue.

—Lori Grunin

ders and, oddly enough, soda cans to impede your progress. Like the company's older game, Tetris, BreakThru's sounds and graphics are pretty but also pretty much incidental to the game.

More humorous than violent, *Sam & Max Hit the Road* (estimated street price, \$55.95;

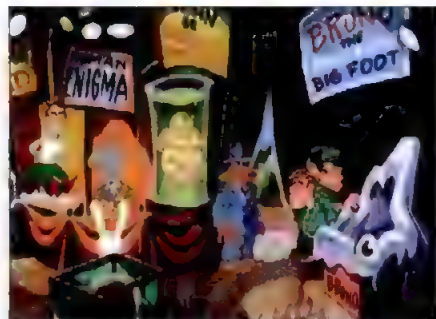
LucasArts Entertainment Co., 800-782-7927) more often goes for the funny bone than the jugular. In this CD-ROM-based adventure game, you'll join Sam (a cerebral canine) and Max (a "naked bunny with an attitude"), two free-lance and freewheeling police creatures who hit every tourist trap

in America, while searching for a defrosted Bigfoot who's wandered off from a carnival sideshow.

The animation, characters, and interface follow in the tradition of LucasArts' previous releases, *Maniac Mansion* and *Day of*

the Tentacle. Like its predecessors, this game is just plain adventure fun. With arcade games such as *Wak-a-Rat* to round out the party, anyone teenaged or older should find this game irresistible.

More traditional sleuthing takes place in *The Psychotron* (\$59.95; Merit Studios, 214-



If you like your adventuring mixed with a dose of humor, hit the road with Sam and Max.



Beautifully rendered 3-D graphics make the surreal *Myst* hard to resist.

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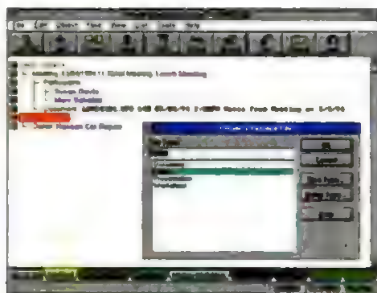
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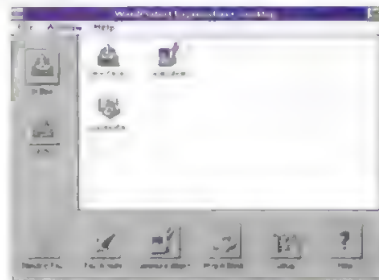
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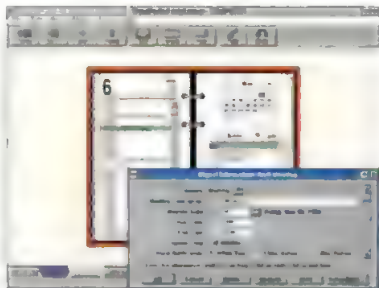
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Games

Simulations

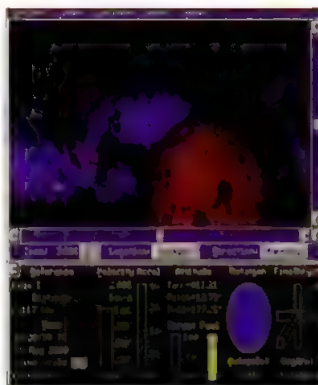
High-Flying Fun from the Comfort of Your Armchair



The documentation for **Microsoft Space Simulator** (\$49.95; Microsoft Corp., 800-426-9400) refers to the game as "your personal gateway to the galaxy." With a total size of 8.4 billion light years, this game lives up to its billing. Designed very much like Microsoft Flight Simulator, *Space Simulator* places you in the cockpit of one of ten spacecraft—some real (Apollo Service Module, Space Shuttle), some not so real (F-79 Galactic Fighter, Zander Freighter)—and lets you fly around the universe. You can

either play in free-flight mode, jumping from galaxy to galaxy in seconds, or opt for one of the two basic missions. The filled-polygon graphics are enhanced with bitmapped images of planets, moons, and nebulae to give the game an appealing look and feel. Space walks, an observatory, and a built-in flight recorder contribute to making this the perfect gift for the PC-toting space cadets in your life.

The more down-to-earth gamer might enjoy **Comanche CD** (\$74.95; Nova Logic, 818-774-0600). This action-packed flight sim puts players in the seat of the Boeing Sikorsky RAH-66 Comanche, the



Microsoft Space Simulator lets you pilot your way across the galaxy.

Army's next-generation attack helicopter. This CD-ROM version includes all three previously released Comanche titles and a total of over 100 missions. The game's stunning texture-mapped, 3-D graphics give the feeling of real flight, and it's often as much fun to maneuver through jagged canyons—at high speed and low altitude—as

it is to blow up the bad guys.

Flight-sim purists will welcome the debut of **Falcon Gold** (estimated street price, \$50; Spectrum HoloByte, 800-695-4263), which brings the latest versions of all the Falcon titles together on a single CD-ROM. Along with Falcon, Version 3.0 (the F-16 jet sim), Falcon Gold includes two other popular flight sims: MiG-29 (the very slick Russian fighter) and Hornet: Naval Strike Fighter (the Navy and Marine Corp's F/A-18 multirole attack aircraft). Also included on this mega-CD are Operation: Fighting Tiger (a series of Asian-theater missions for Falcon 3.0 and MiG-29) and Art of the Kill (a book and utility that teaches dogfighting skills through digitized video sequences). Falcon Gold is impressive in every respect, and



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Games

perfect for the flight sim fan on your shopping list.

Of course, not all simulations are for high-in-the-sky gamers. **Fields of Glory—The Battlefield Action and Leader-**

ly—retreat in complete disarray. The game's stunning color graphics allow the player to zoom directly in on the troops to see them march, charge, fire, and—occasionally—retreat in complete disarray.

Fields of Glory lets the player command the British, French, or Prussian armies at any level, from commander-in-chief in charge of thousands to a brigade commander with 100 cavalrymen. Six different battles and five levels of difficulty enhance the game's appeal and replay value. Finally, for the PC-mariners on your list there's **Aegis: Guardian of the Fleet** (\$69.99; Time Warner Interactive Group, 800-482-3766).

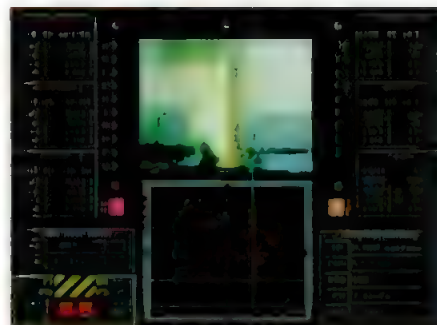
This CD-ROM holds a highly accurate simulation of the Navy's Ticonderoga-class guided-missile cruiser, one of the most powerful and versatile warships ever made. Through a beautifully styled interface and digitized video clips and voice files, the player commands the ship against other ships, subs, and aircraft in a variety of settings from the Falklands to the Persian Gulf.

This is probably the most complicated game in the group, although gamers familiar with Harpoon, or those who've read Tom Clancy or Larry Bond novels, will probably catch on quickly. Even those unfamiliar with modern



The graphics are so realistic in **Comanche CD** you may resent being under constant fire.

ship Game (estimated street price, \$45; Spectrum HoloByte, 800-695-4263) is a unique simulation that recreates the Napoleonic Wars of the early 1800s in miniature, and puts players so close to the action



Aegis gives you such an accurate portrayal of a missile cruiser you might get seasick.

naval combat, however, are likely to get hooked in a hurry.

Any one of these simulations is bound to make the gamers on your shopping list happy. Keep in mind, however, that each of these titles is resource-intensive, so you might want to gift wrap some memory and hard-disk space to go along with the software.

—Michael Ryan

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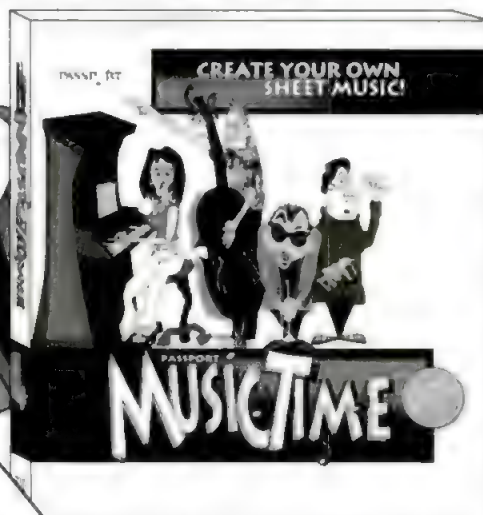
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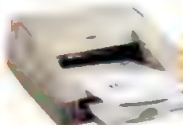
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By Donald B. Trivette

Home productivity sounds like a politically correct term for a twentieth-century sweatshop, but the software we've found is both productive and fun. And there's not an ounce of sweat in any of it. These programs are makers. One makes greeting cards and posters, one makes personalized gifts, and a third makes family trees. There's also a trip maker, a video maker, and a multipurpose graphics program.

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Why stop with greeting cards and banners? Open your own personal shopping network with **Gift Maker** (\$44.95; Maxis, 800-336-2947). This boutique-in-a-box puts your favorite designs on more than 40 gift items, including T-shirts, baseball caps, mugs, and mouse pads. Gift Maker includes templates for the various items, as well as a large selection of ready-made graphics. You can also import illustrations created in other PC drawing programs. The goof-proof software previews



your design and fills out the order form... all you have to do is mail or modem your design to the fulfillment house.

And while you're in the mood to make holiday gifts, think about making a family tree using **Family Tree Maker Deluxe CD-ROM Edition** (\$60; Banner Blue Software, 510-794-6850). This CD-ROM-based package provides the perfect means for organiz-

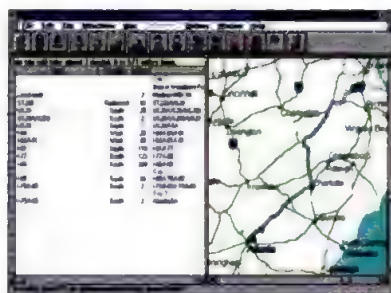


Gift Maker lets you use your PC to design and order personalized gifts.

ing all those aunts and cousins and half-brothers. It's a snap to connect individuals into families and to add new members as they are discovered. Included on the CD-ROM is an index of 150 million names from historical sources such as the

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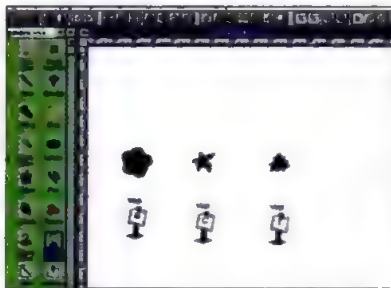
Pick from the quickest, shortest, or most scenic routes and the software prints a road map and an

itinerary showing every segment and crossroad on the journey. Don't forget to take your video camera; TripMaker recommends historic sites, parks, and scenic vistas along your route.

Once home, you can use **VideoDirector 2.0 for Windows** (\$119.95; Gold Disk, 800-982-9888) to put all those video segments into something resembling a story line—and edit out the embarrassing moments when you thought the camera

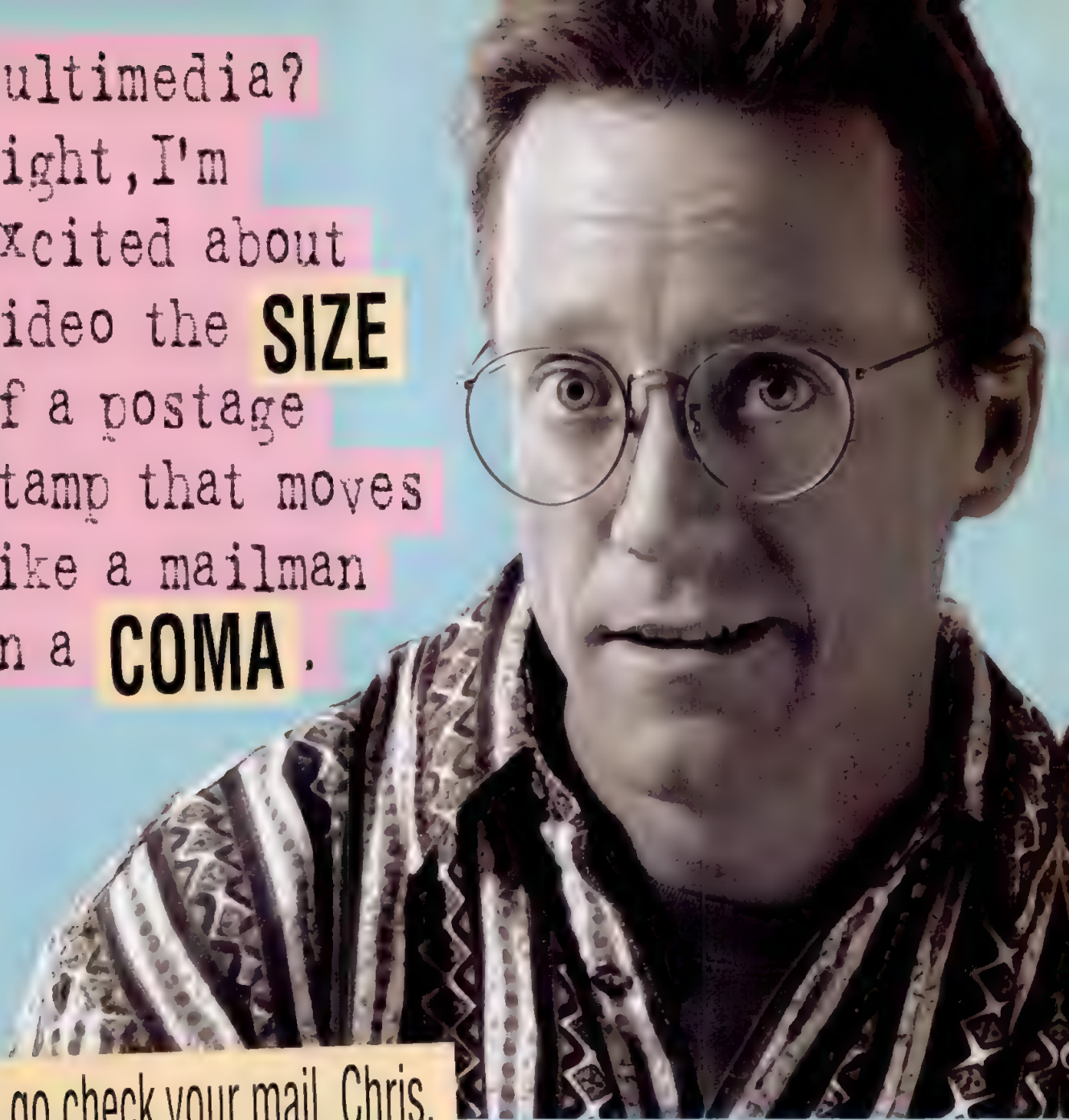
wasn't rolling. For hardware, you'll need a source deck (camcorder or VCR) with the LANC (Ctrl-L) interface and a record deck (VCR) with an infrared interface. VideoDirector supplies the software and a cable that connects your PC's serial port to the two video devices. You name and arrange segments, and then the software automatically controls the camcorder and VCR to record a new tape.

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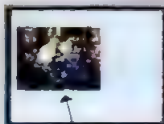
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SIGMA DESIGNS

Look It Up

By Donald B. Trivette

Reference works aren't supposed to be fun, but we found six titles that are. Together, these titles cover the arts and sciences, movies, history, contemporary culture, biology, and medicine as no printed book ever could. They encourage you to explore nooks and crannies beyond the bounds of your initial query and to thread your way from one topic to another.

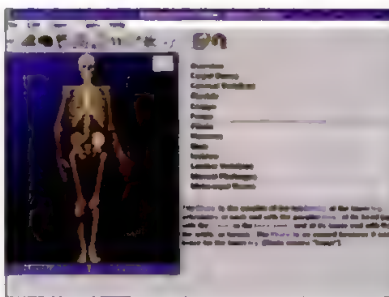
An encyclopedia is supposed to have substance, and **Microsoft Encarta '95** (\$99.95; Microsoft Corp., 800-426-9400) surely does. Revised and updated for 1995, this general-subject-reference CD-ROM



clips, motion picture stills, dialog excerpts, sound track music, cast lists, and biographies make this the ultimate film-buff refer-

ence. This latest edition covers more than 20,000 movies with reviews drawn from such

With a skillful blend of audio, video, and still photography, the trip takes about 30 minutes. Of course, you can interrupt the presentation at any



BodyWorks is a comprehensible reference to human anatomy and physiology.

point and wander off on side journeys into the large collection of supplemental material.

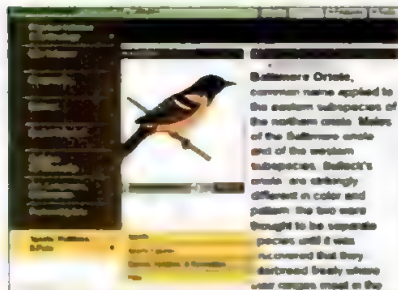
As famous for its interviews as for its centerfolds (well, almost), *Playboy* magazine has compiled a stellar collection of conversations from the years 1962 to 1992

people such as Ansel Adams, Michael Jordan, Dan Rather, and Robin Williams. As a bonus, you can listen to some of the original interview tapes. Surprisingly, the material is as fresh today as the day it was published. Consider Ted Turner in August 1978: "What's happened to sports today? There are a million guys who have to work in a factory for \$12,000 a year. If you asked any of them if he'd like to play [baseball] for \$18,000, would

he turn it down?"

If some of those workers did step into major-league sports, they could use **BodyWorks 3.0** (\$69.95; Software Marketing Corp., 800-545-6626) to pinpoint their aching muscles and dislocated joints. Anatomical drawings of the body's internal systems—skeletal, muscular, cardiovascular, and nervous, to name a few—are beautifully rendered. Rotating 3-D views, pronunciation of tongue-twisting medical terms, and a huge index with phonetic lookup make this CD-ROM an indispensable home reference.

Medical HouseCall (\$99.95; Applied Medical Informatics, 800-584-3060) is a noble companion to BodyWorks. For less than the cost of a visit to the emergency room, you get a detailed reference to the ills and injuries that can befall the body. Nutrition, poisons, and drug interactions are covered in some detail. □



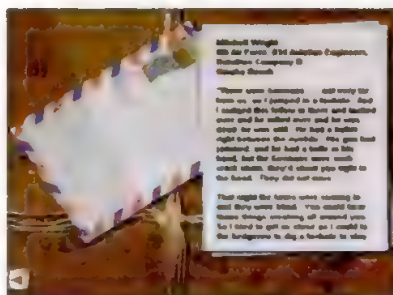
Microsoft Encarta '95 lets users access its 26,000 articles in several different ways.

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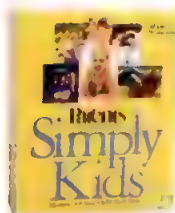
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Coming Up

The 11th Annual Awards for Technical Excellence

After weeks of intense debate, *PC Magazine's* editors come together to honor 1994's most important achievements in hardware and software with the personal computer industry's most coveted awards. Here are the groundbreaking new technologies that will drive personal computing to new heights in the coming year—and the people behind them.

Home PCs

As the holiday shopping season once again kicks into gear, you may find yourself shopping for a new PC for your family or for your home office. In our review of 24 home-oriented computers, we take a look at everything that goes into a great home machine, from multimedia goodies like CD-ROM drives, sound boards, and speakers to Windows front ends, software bundles, and telephony features.

PC-Based Voice Recognition

Over the past year, voice recognition on the PC has grown from a mere curiosity to a powerful and practical technology. To help you get oriented, we survey the state of the art in voice recognition products, from simple navigators for controlling applications by voice all the way to sophisticated dictation systems. We also look at development platforms that let C and Visual Basic programmers build custom voice-driven applications.

32-Bit Operating Systems

The world may be waiting for Microsoft Windows 95, but if you want to upgrade to a true 32-bit operating system today, you have two brand-new choices. Both IBM OS/2 Warp, Version 3, and Microsoft Windows NT, Version 3.5, are packed with OS innovation, but does that fact really make a difference on the desktop? PC Labs' tests reveal the strengths and drawbacks of the two environments and help you decide whether you're a good candidate for a 32-bit OS upgrade now.

Free Utility

To every thing there is a season, and a time for every purpose under heaven. But how do you remember? The problem with most software is that it only beeps to remind us about a task. Shouldn't the computer just *do* the task and tell us later? Well, now it can with Scheduler. This Windows utility provides a simple but powerful service: It will run programs on a schedule you provide.

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By Don Willmott

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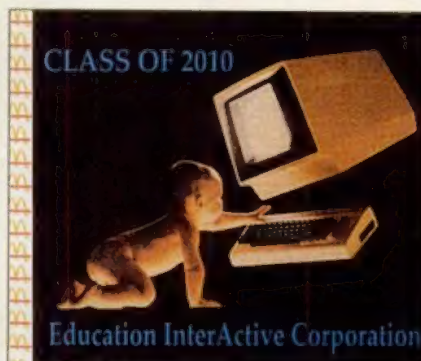
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